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Compound Tubular Steam Boiler.

The question of the best proportions to be adopted in the design of steam boilers is one which has received much attention from engineers, and one which has been the subject of many practical tests. Chief Engineer Isherwood, after a long series of experiments on marine boilers, decided that the proportion of heating surface to grate surface should be as 25 to 1, and the proportion of grate surface to tube area should be as 8 to 1 to secure best results.

The proportions now commonly adopted in the construction of boilers set in brick work are as 30 to 1 for the ratio of heating surface to grate surface, and as 8 to 1 for the ratio of grate surface to tube area.

We have before us the compound tubular boiler, which in respect to these proportions, departs very widely from the prevailing practice, with what results will be seen as we go on.

The general construction of this boiler will be understood by a glance at the accompanying engraving.

It consists of two shells or cylinders both of the same length, but of different diameters. The larger shell forms the boiler proper, while the smaller one forms the steam drum. Free communication between the two is obtained by means of three connections, one at each end and one in the center, as shown. The larger shell is filled with tubes placed in vertical rows to insure a free circulation. The water is carried up to about the center line of the drum, as shown in the engraving, and, above this line, the outside of the drum exposes steam-heating surface to the escaping gases, on their way from the front of the tubes to the chimney. Except in this provision, the brick work which encloses the boiler is arranged on the same general plan as the usual setting of common tubular boilers.

The boiler is strongly braced, the heads being held by the tubes alone. By this means the strain is evenly distributed over the heads, and an even expansion produced, while in ordinary tubular boilers the bracing is accomplished partly by the tubes, which are subjected to the heat of the passing flame, and partly by iron rods which have the same temperature as the water in the boiler.

The boiler is readily cleaned and washed out by removing hand-hole plates at the ends.

To enable the reader to form a definite idea of the proportions and efficiency of this boiler, we publish herewith the dimensions of a set of three boilers of this type, together with the results of a test of the same, conducted by George H. Barrus, Expert Engineer, of Boston. The boilers tested were set in the usual manner, in brick work, and were fitted with the Ashcroft-Martin balanced doors and wrought iron grate bars.

DIMENSIONS OF EACH BOILER.

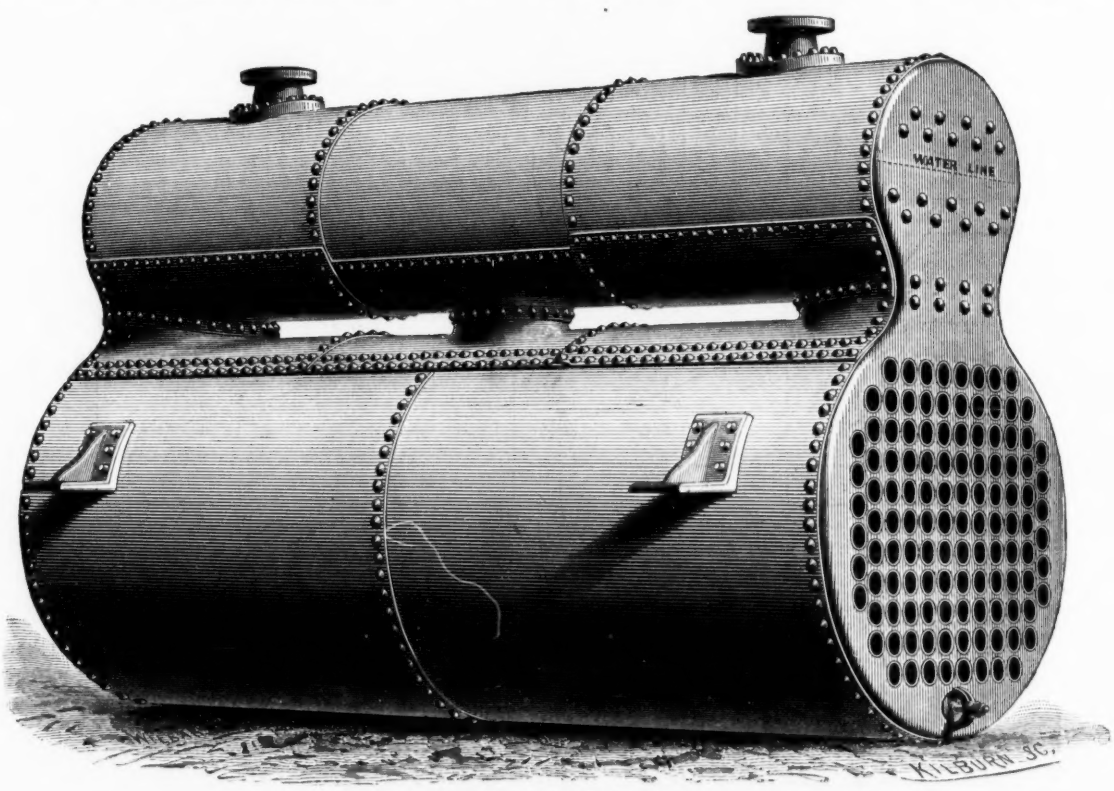
Length of boiler	15 ft.
Diameter of main shell	5 ft.
Diameter of drum	34 in.
Number of three-inch tubes	140
Size of grate	5 ft. × 6 ft.
Height of chimney	100 ft.
Cross area of chimney flues	11.1 sq. ft.

COLLECTIVE QUANTITIES.

Grate surface	90 sq. ft.
Water-heating surface	5850 "
Steam-heating surface	300 "
Tube area for draught	17.3 "

RATIOS.

Water heating to grate surface	65 to 1
Steam heating to grate surface	3.3 " 1
Grate surface to tube area	5.2 to 1
Grate surface to chimney area	8.1 " 1



COMPOUND TUBULAR STEAM BOILER.

The steam generated by these boilers supplies a double cylinder non-condensing engine having 22 in. by 48 in. cylinders of the Buckeye pattern, developing from 300 to 350 indicated horse power. Steam is also supplied for heating and drying purposes. The feed water is heated on its way from th steam pump to the boilers by exhaust steam from the engine.

The tests determined the evaporation of the boilers per pound of Cumberland coal, under the conditions of every-day work for three consecutive days. The fires were lighted each morning on clean grates and burned out at night. The amount of wood and coal consumed, the actual weight of the water pumped, and all the observations were taken with necessary care. The total evaporation each day was taken, to commence with the lighting of the fires, and to end at the time of lighting them on the following morning.

The average results of the three days' test are, principally, as follows:

Duration	35.5 hrs.
Fuel consumed	34,938 lbs.
Ashes	2,365 lbs.
Percentage of ash	6.7 %
Combustible	32,573 lbs.
Water evaporated	388,044 lbs.
Boiler pressure	81.7 lbs.
Temperature feed water	205°
Temperature escaping gases	389°
Fuel per hour per sq. ft. grate	10.94 lbs.
Water per hour per sq. foot heating surface	1.87 lbs.
Water, per lb. fuel, under observed conditions	11.08 lbs.
Equivalent, per lb. fuel, from and at 212°	11.55 lbs.
Water, per lb., combustible under observed conditions	11.91 lbs.
Equivalent, per lb., combustible from and at 212°	12.42 lbs.

Numerous calorimetric tests of the quality of the steam showed that it was in a perfectly dry condition on leaving the boilers. It appears from the above that the boilers evaporated about 11,000 lbs. of water per hour.

The Buckeye engine showed on a three hours test a consumption of 29.7 lbs. of steam per I. H. P. per hour. On this basis the boilers developed a duty of about 370 horse power, which is practically their full-rated power.

A common tubular boiler of the size of the main shell of this boiler would be rated at about 75 horse power, while the rating of this is 125 horse power. The average performance of various boilers is given as 10.61 lbs. of water per pound of Cumberland, combustible from and at 212°, which is 1.81 lbs. less than the performance of the compound boilers given above.

It appears thus that the compound boilers give 66⅔ per cent. more boiler power in a given floor space, and produce 17 per cent. more steam from the same amount of Cumberland coal than the common horizontal tubular boiler.

The boiler is manufacured by The National Steam Boiler Company, 51 Sudbury street, Boston, Mass.

Cushion Adjustment in Engines.

BY S. W. ROBINSON, DEPT. MECH. ENG., OHIO STATE UNIVERSITY.

FROM A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

What follows is applicable, with a greater or lesser degree of nicety, to steam engines, air engines, compressors, etc.

This subject has been treated by several prominent writers, and rules have been given for adjustment, some of which are much simpler, and give quite different results than others. The present object is two-fold. First, to determine what rule deserves acceptance by such as prefer to know what they are doing; and, second, to adapt the rule to ready practical application.

The simplest rule among them is indorsed by Prof. H. T. Eddy, of the University of Cincinnati, and credited to Hartnell and to Gray, in a little treatise on Thermodynamics written by him. This rule may be stated thus: The initial cushion volume is to the cylinder volume as the clearance volume is to the admission volume, all volumes being reckoned from the bottom of the clearance.

A rule given by Cotterill, "On the Steam Engine," see p. 229, eq., (A), is quite different in appearance and results, as well as being sadly wanting in convenience of application. The equation is irresolvable in terms of the quantity usually wanted.

The first rule named would give no cushion for non-expansive cylinders, while the second one would, as any good rule evidently should.

In the place of reviewing one or both of the tedious and indirect processes and discussions by which these rules have been obtained, let us adopt a direct rational course to the rule sought. In this let us adopt, with others, the hyperbolic law of expansion and compression. Though this law is not in strict accord with the known theory of expansion, except for the isothermal curve for gases, yet in practice it is found to represent the actual curves, in most cases in steam engines at least, better than the so-called theoretical ones.

Take Fig. 1 as the general form of diagram, with the volumes and pressures as indicated—viz. p_1, p_2, p_3—as the pressure of admission, release, and of exhaust, respectively, and v_1, v_2, v_3, v_4, v_5, v_x, v_8 the volume of admission, of release, of initial compression, of clearance, of compression supposed carried to p_1, and of some volume greater than that of the cylinder. The stroke is represented by J, G.

Now for a basis of solution: take the cushion line I, M, B, in such position that if varied a trifle to some other very near position, as at R, a certain small area M, R, I, S, M, will be takenf rom the diagram

area; while the volume of cushion, compressed to p_1, will be greater by B, b, in Fig. 1. The volume of steam admitted will be $v_1 - v_s$, the volume v_s being that restored by the cushioning. That is, though the piston stops at J, on its return, and the cushion line stops at M, yet this cushion contained steam compressed by the piston moving back to the vol. A, B; or by the piston stopping at the vol. O, J, and then the contained steam compressed by admitting high steam and raising pressure to P_1, the result will be the same volume, A, B, as due to the cushion steam raised to the pressure P_1, consequently the steam admitted each stroke will be $v_1 - v_s = B, D$, for the outside cushion line. The corresponding area of the indicator diagram will be $C, D, E, F, I, M, C, = a$. When the cushion line I, M, runs very near K, the element cut off or added in the small variation I, S, M, R, is much less for a given change B, b, of volume, than when I, M, runs very nearly to the top of the diagram, at C. In the latter case, the area I, S, M, R, on account of its width at R, S, being greater than B, b, is a greater part of the whole area a, than the volume B, b, is of the whole volume B, D. But when I, M, is near K, the reverse is true; consequently it appears that the best adjustment is somewhere intermediate; or, as is evident from the discussion, exactly where

$$Bb : BD :: ISMR : a.$$

That is, when the variation of steam admitted is to the whole steam admitted, as the variation of area is to the whole area of diagram.

This relation, apparently so simple, is not of much service in practice without further treatment.

In the paper presented to the Society, this equation was transformed by analysis, and made to express the best adjustment, in the manner indicated in Fig. 2, viz., with notation as before, the area shaded in horizontal lines should equal that shaded in vertical lines, and at the same time give the relation,

AC:AD::OH:OP,

which is easily obtained by the straight lines, H, C, and P, D, meeting on the line, O, A, as indicated.

In practice, one of these conditions is involved in the other; that is, if we assume equal areas, the proportion may not come out right, and, if we assume correct proportion, the areas may not come out equal. We, therefore, still have trouble in the application for want of directness and simplicity. Even if direct, the care and labor involved in securing the desired accuracy in laying out diagram, measuring areas, etc., would be fatal to the application.

Fig. 2 indicates that when the points H and P, are determined correctly, also the areas 1 and 3 fixed, the area 2 may be varied by raising or lowering the back pressure line I, F, and thus an equality of areas obtained. But in practice the back pressure is usually one of the given quantities, and if the back pressure required to balance the areas does not happen to be that given, a new trial diagram must be drawn, with different points, H and P. By collecting such trial results a table could be soon written out, from which any practical problem may be readily solved.

Hence, in a table we have the key for the practicalization of the problem.

The table here given has been worked out by a systematic procedure of this kind, fully detailed in the original paper, but as this together with the analytical proof of the equality of areas, pointed out above, is too complex for our present purpose, we pass to the consideration of the table.

Note to the Table.—In this table—

v_4 = vol. of clearance.

v_2 = vol. of cylinder + clearance.

v_1 = vol. of admission + clearance.

v_s = vol. of cushion + clearance.

p_1 = absolute pressure of admission.

p_s = absolute exhaust pressure.

That is: suppose there be added to the stroke volume, a volume whose diameter is that of the cylinder and length such that its volume equals the clearance volume, This clearance volume is included in all the volumes named in the table or in this note, and should always be subtracted from v_s, when the latter is obtained by aid of the table.

The ratio of expansion above is—

$$r = \frac{\text{vol. of cylinder} + \text{clearance}}{\text{vol. of admission} + \text{clearance.}}$$

Ratio of clearance above—

$$c = \frac{\text{vol. of clearance}}{\text{vol. of cyl.} + \text{clearance.}}$$

Ratio of cushion above—

$$s = \frac{\text{vol. of cushion} + \text{clearance}}{\text{vol. of cyl.} + \text{clearance.}}$$

Probably the most convenient result is the point in the return stroke at which the cushion or compression should begin. This divided by the stroke is

$$\frac{\text{return to cushion}}{\text{return stroke}} = \frac{v_2 - v_s}{v_2 - v_4} = \frac{1-s}{1-c} = \frac{1-\text{cr. tab. val.}}{1-c}$$

This fraction multiplied by the length of stroke in inches gives the distance in inches of return stroke to where the cushision is to begin.

TABLE FOR FACILITATING THE ADJUSTMENT OF CUSHION IN ENGINES.

Values of $\frac{p_1}{p_s} = \frac{\text{absolute pressure of admission.}}{\text{absolute back or exhaust pressure.}}$

CLEARANCE. $c = \frac{v_4}{v_2}$	EXPANSION. $r = \frac{v_2}{v_1}$	These values $= \frac{s}{cr}$ where $s = \frac{v_s}{v_2}$, $c = \frac{v_4}{v_2}$, $r = \frac{v_2}{v_1}$												
		1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2	2.4
.1	1.	1.	1.1	1.2	1.4	1.6	1.8	2.0	2.3	2.6	3.2	3.8	6.2	25.0
	2.	2.	2.2	2.4	2.7	3.1	3.6	4.2	5.0	6.4	8.0	11.3	14.0	
	4.	4.	4.5	5.1	5.9	6.8	8.3	11.2	24.0					
	6.	6.	6.6	7.6	10.3	15.2								
.05	1.	1.	1.1	1.2	1.3	1.4	1.6	1.8	2.1	2.4	2.8	3.4	5.0	11.0
	2.	2	2.2	2.4	2.7	3.0	3.5	4.0	4.7	5.4	6.3	7.3		
	4.	4.	4.5	5.0	5.6	6.1	7.1	8.2	9.8	12.0	16.0	24.0		
	6.	6.	6.6	7.4	8.5	9.7	11.2	14.0	17.5					
.025	1.	1.	1.1	1.2	1.3	1.4	1.5	1.7	2.0	2.3	2.7	3.3	4.6	9.0
	2.	2.	2.2	2.4	2.7	3.1	3.5	3.9	4.4	4.9	5.7	6.7	11.5	25.0
	4.	4.	4.5	5.0	5.5	6.1	6.9	8.0	9.2	10.7	12.6	16.0		
	6.	6.	6.6	7.4	8.4	9.4	10.8	12.6	14.6	17.2	23.0	28.0		

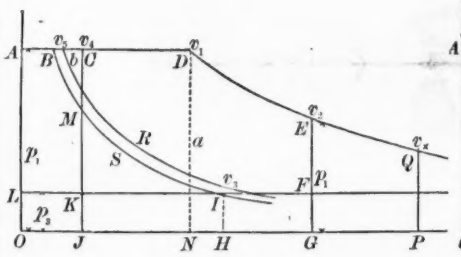


Fig. 1

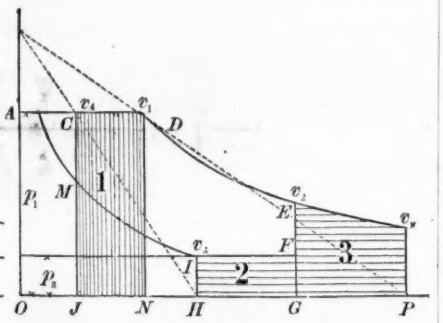


Fig. 2

EXAMPLES.

To illustrate the application of the table the following examples are worked out:

1st. Given: $c = 0.1$ $r = 2.0$ $\frac{p_1}{p_s} = 6.0$.

Looking in the table we find $c = .1$ brings us in the upper third of table; and for $r = 2$. we look in the second line of upper third. Along this line in the body of the table we find $\frac{p_1}{p_s} = 6$. comes between "5.0" and "6.4", over which, in top line of table, we find the value of $\frac{s}{cr}$ to be 1.7 and 1.8 respectively. Interpolating between the latter, for the value at which $\frac{p_1}{p_s} = 6$, in body of table, we find the tabular value sought to be 1.77. Hence

$$\frac{\text{Return to cushion}}{\text{Return stroke}} = \frac{1 - \text{cr. tab. value}}{1-c} = \frac{1 - 0.1 \times 2.0 \times 1.77}{1 - 0.1} = \frac{.646}{.9} = .718.$$

Consequently the effective exhaust valve closure should occur at about $\frac{72}{100}$ths of the return stroke. The cushion stroke is about $\frac{28}{100}$ths of the stroke.

2d. Given: The clearance volume = 100 cubic inches. The actual piston displacement = 900 cubic inches. Piston displacement at time of cut-off = 650 cubic inches. The forward pressure = 90 pounds per square inch absolute or 75 pounds by steam gauge, exhaust, or back pressure, one atmosphere, or 15 pounds, as is nearly the case in non-condensing engines.

Then the value to look for in the first column of table under c is $\frac{100}{900+100} = 0.1$, which brings us in the upper third of the table. In the second column, under r, the value is $\frac{900+100}{650+100} = \frac{4}{3} = 1.333$, which brings us between 1 and 2 in the second column, under r, and a third the way from the 1 to 2. The value to look for in the body of the table is—

$$\frac{\text{90 lbs. absolute pressure}}{\text{15 lbs. absolute back pressure}} = \frac{75+15}{15} = 6.0$$

and is to be looked for opposite the $r = 1.333$. Interpolating for a third the way from 3.2 to 8.0, we get 4.8: and for a third the way from 3.8 to 11.3, we get 6.3. Hence the value in the top line of table is between 1.9, and 2.0, and nearest 2.0, because 6. is nearer 6.3, than 4.8. By interpolating, or taking $\frac{1}{5}$, the difference from 6.3, we get 6.; and taking $\frac{1}{5}$, the difference between 1.9, and 2.0, from 2.0, we get 1.98 as the correct tabular value. But by the rule—

$$\frac{\text{Return to cushion}}{\text{Return stroke}} = \frac{1 - \text{cr.} \times \text{tab. val.}}{1-c} = \frac{1 - .1 \times \frac{4}{3} \times 1.98}{1 - .1} = .818$$

Hence the piston makes .818 of its return stroke when cushion begins. The length of the cushion is 1 — .818 = .182 of the stroke.

3d. Take $c = 0.08$ $r = 1.$ $\frac{p_1}{p_s} = 8.$ Then, in the c column, 0.08 lies $\frac{2}{5}$ the way from 0.1 to 0.05. And r being 1., we must interpolate for the 8. in the body of the table, as lying $\frac{2}{5}$ the way from $r = 1$. in the upper third, to $r = 1.$ in the middle third of table, or $\frac{2}{5}$ from 6.2 to 5.0, = 5.7, and $\frac{2}{5}$ from 25. 0 to 11. 0 = 19. 4. Now, 8 is $\frac{1}{6}$ the way from 5.7 to 19.4, and so we add to 2.2 of the top line of table $\frac{1}{6}$ the difference between the 2.2 and the next value 2.4, giving the quantity 2.23 as the tabular value. Hence—

$$\frac{\text{Return to cushion}}{\text{Return stroke}} = \frac{1 - \text{cr.} \times 2.23}{1-c} = \frac{1 - .08 \times 1 \times 2.23}{1 - .08} = \frac{.822}{.92} = .893$$

Compression length = .107 of stroke.

These examples have also been worked by Hartnell's rule, as given by Eddy. The results for cushion length are .111, .038, and .0 respectively. Arranging for better comparison, we have example—

	No. 1.	No. 2.	No. 3.
Above rule....	.282	.182	.107
Hartnell's rule.	.111	.038	.000

A little inspection of the diagrams shown will prove that the value .000 is incorrect, and hence all values by Hartnell's rule must be incorrect also.

Tools for Locomotive Shops.

BY A. DOLBEER.

The sketches herewith show some tools which we have in our shop. I don't know whether they are in use anywhere else or not. If so, I have never seen them. The first, shown in Fig. 1, is an arrangement for

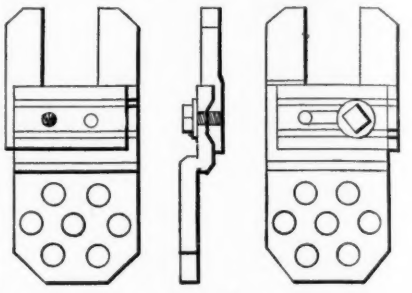
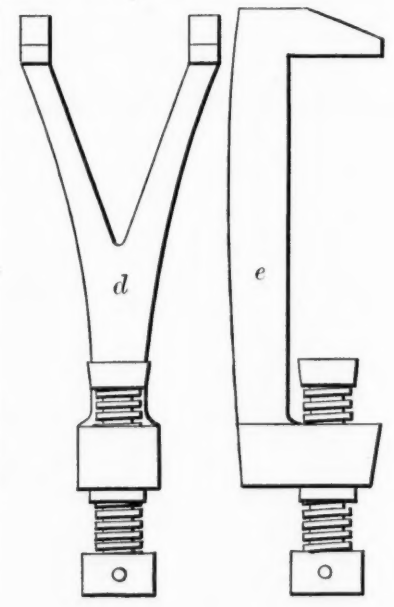


FIG. 2.

use in replacing locomotive driving springs. It consists simply of an iron hooked fork, d and e, having a screw attached to it. In removing or replacing the springs of locomotives all sorts of "dodges" are resorted to in different shops, for relieving the strain upon the equalizing bars, in order to remove



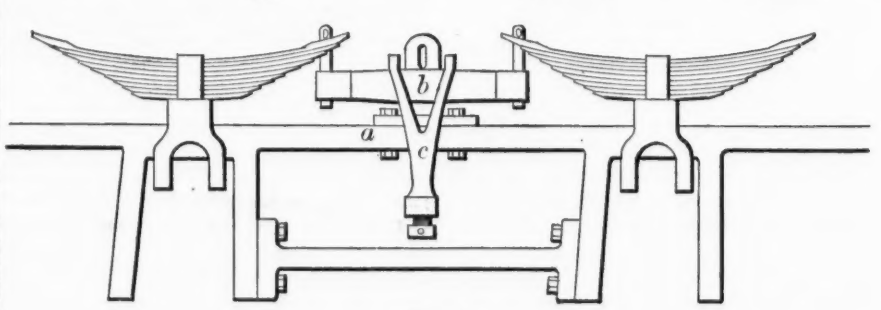


FIG. 1.

the keys. Chains, nuts, and pinch bars are freely used, and it is not unusual for a man to get a "plump" upon the nose with a $\frac{7}{8}$ inch hexagon nut. The convenient device c, is shown, applied in practice to the frame a, the hooks firmly griping the bar b. By tightening the screw the key may be quickly removed, after which the springs are easily and quickly removed. The rest will be apparent without further explanation, and I venture to say that, after any one has tried it, it will need no commendation. The other device is an adjustable carrier, to be used in turning bolts, or anything with square, hexagon, or any other angular head, and is shown in Fig. 2. It is simply a piece of flat iron bent into the form shown, and has

a sliding jaw, adjustable for different sizes, and is held by a set screw. The circle of holes shown are for attaching the carrier to the face plate of a lathe.

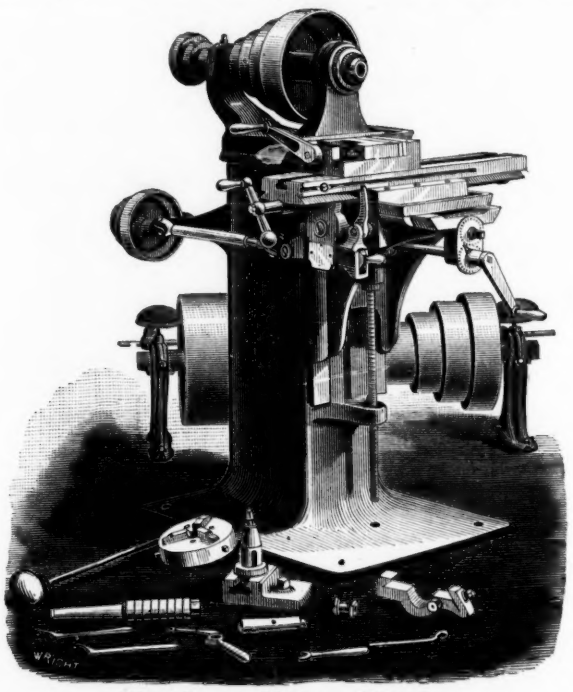
I do not boast of this very much as my invention, but I got it up to do away with the abominable sheet-iron arrangements which litter up the average shops. Thus far I do not see much change in that direction. However, some of our best lathe-men like them very much.

Capabilities of Steam Boilers.

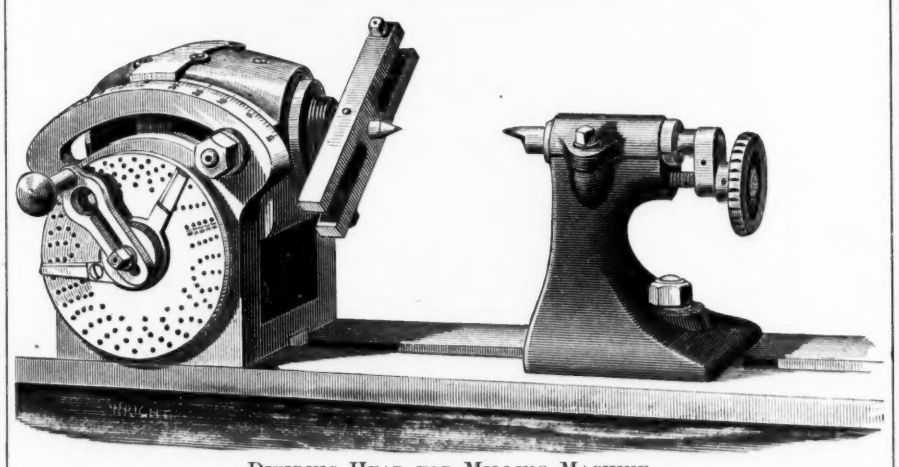
BY WM. J. WILLIAMS.

The capability of any steam boiler to withstand a given working pressure, whether based on known tensile strength of the material used, by actual tests of portions of the iron from which it is made, or from supposition because it is branded with a certain mark, and during the conversion may prove by its working, its right to bear the brand, is of very great importance. In the first contingence it is known that the iron will sustain a certain number of pounds before rupturing; in the second it is assumed that it will also bear a certain strain before breaking, and so far as the knowledge of persons competent to judge such matters, the materials contain all the necessary qualities to make a good steam boiler. Let it be assumed that a boiler has been designed by one competent to do so, and his ideas faithfully carried out by experienced workmen, so far as human judgment and skill can execute, the result is a boiler as near perfection as possible. However unanimous may be the opinion of qualified persons as to a piece of good workmanship, they are not so well agreed as to what is the safe working pressure of such a boiler; and this arises from using different data. While one may feel justified to take the whole strength of the proved tenacity of one square inch of the iron in the plates, less a certain percentage for single or double riveting; another, of more conservative thinking, admits the truth of its ability to withstand a given weight, but is not willing to trust it to that extent in a steam boiler. Even in percentage of strength left, after the rivet holes have been made, there is not an unanimity of opinion: the formula of Sir Wm. Fairbairn, viz.: 50,000 pounds ultimate strength of the iron, less 56 and 70 per cent. for single and double riveting is no longer adhered to in all cases, but, nevertheless, is looked at by some as good conservative boiler engineering; while those of a different opinion may think that it was a very good formula for the time in which it was made. To say that the march of improvement has not invaded the boiler shop would be an assertion difficult to prove; while the spacing of the rivets may be farther apart than formerly, the rivet holes smaller, thereby increasing the percentage of material left, and augmenting the strength of the boiler, and when double riveting in longitudiual seams is done, a different disposition of the rivets of former times, so far as calculations or actual experiments to pull two joining sheets apart, may show an increased strength over former practice. But if the boiler is to sustain an increased pressure, in extent equal to the supposed or real addition of strength not previously attained, it is not going to be any safer than its predecessor. Whether one-fifth or one-sixth of the estimated bursting pressure shall be the assumed safe working load there is a difference of opinion. It is not more strange that there should be a difference of opinion between two or more persons as to the strength of a steam boiler than there should be in their differing about any other important matter; but while they may differ about points of theology and hurt no body, yet mistaken views in regard to the strength of a steam boiler may have a very unwelcome termination. Therefore it is very necessary that it were possible that those who design and make steam boilers should come to some common understanding in regard to the matter. It is well known to practical men that many boilers work under many conditions, and that some of these conditions, from the nature of the work which the boiler has to furnish steam, cannot be altered; another may be using a fuel with which it is impossible to maintain a fire of anything like uniform intensity.

To illustrate some of the common conditions under which steam boilers are worked, and the amount and kind of wear to which they are subjected; and, in order to arrive at a determination, whether those of like dimensions and quality of iron should be subjected to the same working pressure for all kinds of uses, let the examples be tubular boilers of, say, 54 inches diameter: plates, .375″ thick; longitudinal seams, double riveted; tensile strength of iron, 55,000 pounds per square inch: let its construction, in all particulars, conform to the requirements of the United States Board of Supervising Inspectors, so that the example shall be entitled to carry the pressure allowed for a cylindrical shell, as indicated by them, viz.: 152.77 pounds; let the first boiler be designed to furnish steam for an engine of any given power, and not performing at any time more work than that for which it was built; let the fuel used be a good quality of coal, and the boiler kept free of incrustation; under such conditions it would be feasible to keep the pressure constant, or nearly so, thereby subjecting the boiler to a minimum amount of changes in temperature. Under these stipulations, such a boiler may be perfectly safe, in the general acceptation of the term, and may reasonably be expected to have the ordinary life of a tubular boiler: let the second boiler be used for the same purpose as the first, but fired with a fuel, the heat from which is never constant—fitful flashes of heat; under this head, may be mentioned shavings, sawdust, bad coal, and pea and dust, such fuels subjecting the outside of shell to maximum amount of changes in temperature and a probable greater variation of pressure; under such conditions it is exceedingly doubtful whether it is the part of wisdom to trust this boiler with a working pressure of 152.77 pounds. Let the third boiler be required to furnish live steam for some manufacturing operation, assume it to be a dye house, any place where everybody about the establishment, except the man who makes the steam, has a right to use it as he pleases; let the fuel be of the best, there is no uniformity of pressure here from morning to night—a constant succession of changes of pressure, of temperature, of expansion and contraction; if there be any doubt whether a boiler of the second condition to sustain a working pressure equal to the first, there would seem to be no manner of doubt of the impropriety of carrying a pressure equal to that assumed in the first example. The first is a boiler being worked to its economic evaporative capacity only, all the conditions in regard to its management for economy and safety are within the range of human possibilities; in the second the most perserving attendance can never fill the requirements considered necessary for perfect safety, and in the third example it may be said to be never partly filled; it is no longer evaporative economy, but evaporative ability, pressed to its work by intense firing accompanied by widely different pressures; it is simply a battle with fire and water, with the boiler between them to receive all the shocks of the impending struggle. Yet the safety valve is loaded to attain the same pressure as the boiler that is being worked to its economic rate. Custom says it is no larger in diameter, it is no thinner, it is as well made as its more fortunate prototype, and it must sustain the same load whenever it is possible to compel it to do so. Other conditions just as trying to material and workmanship could be cited, formulas may continue to be made, to ascertain safe working pressures. When the conditions under which steam boilers are actually working are known, and not what they are supposed or intended by the maker to do, would greatly modify some of the formulas in existence. If that arch-enemy of the steam boiler and stumbling block of the world's steam users, viz., boiler scale, could be avoided, they then might be trusted with more faith to perform what is now required of some of them. In too many of them there is never any systematical attempt, even, to do the best that can be done to keep them reasonably clean of incrustation; they are subjected to usages that few but those who spend their lives about them know little of; and as there seems to be a tendency whenever any increased strength from material or workmanship is attained, to further increase the burden. In conversation with an experienced engineer on the vicissitudes of steam boilers generally, he said too much faith is put in iron after it is made into a steam boiler. Although steam has been harnessed to drive machinery to supply nearly all the wants of man, it breaks from it sometimes in a manner that is by no means altogether satisfactorily accounted for; and since man's proud distinction, inventive faculty, have not been able to prevent terrible disasters, he may encourage prudence and precaution.



NEW POWER MILLING MACHINE.



DIVIDING HEAD FOR MILLING MACHINE.

New Power Milling Machine.

This machine, together with 10-inch centers (described), is designed to meet the wants of tool makers, machinists, and others requiring an accurate dividing, and well-made milling machine. The spindle is of steel, front bearing 4 inches long, 2⅛ inch diameter, and has a 11-16ths' hole clear through; front end tapered to 1¼ inches to receive arbor. The threads and tapers in the end of both milling machine and dividing head-stock spindles being alike allow tools, fitted to either, to interchange. The boxes are composition metal, and are provided with ready means of compensation for wear. The spindle is driven by a 2¾ inch belt on a cone pulley of four grades. There are three changes of feed.

For removing cutter arbors from spindle, a plunger accompanies the machine. A suitable resting place is provided on feed bracket, in rear of machine, for plunger when not in use. The top of carriage can be lowered from center of spindle to 17 inches below. The cross slide has an adjustment of 6 inches to and from the column. The carriage is 28 inches long by 5 inches wide, and can be fed automatically or by hand—18 inches.

The feed screw is double thread, giving quick return movement. Stops are provided for hand feed. The trip is so arranged that the automatic feed stops will operate with the carriage traveling either way. On the cross slide screw, and elevating screw, is an index plate, with compound graduations in thousandths of an inch. The feed gearing is inaccessible to dirt and chips, being on the front of the machine enclosed in a neat iron box. The feed worm is self-oiling, being surrounded by an oil box.

The dividing head and tail stock, shown in the cut, is well adapted to the uses for which it is designed. It is compact and well made. With it gears can be accurately spaced, mills cut, of straight, conical, or irregular forms, fluting of taps and reamers, gashing of worm wheels, etc. The slots in the stock allow the head to be elevated from a horizontal to a vertical position, and by supplemental slots in the elevating head, in which the T heads of clamp bolts slide, the head can be depressed to 30 degrees below a horizontal line, and 5 degrees beyond a vertical, making 125 degrees of change, all determined by graduations on stock. The rigidity of head is alike at any point of elevation or depression within its compass. With the head in its horizontal position, these centers will swing pieces 10⅜ inches in diameter, and they will take in 15 inches between centers on a slide, 28 inches long.

The spacing worm gear is made in halves, and all points liable to wear are provided with means of compensation for wear. Three index dials accompany the head, dividing all numbers up to 50 and as many others, as an every-day machine-shop practice may demand. The spindle of elevating head has a taper hole clear through, and end of spindle is threaded to receive chuck, allowing pieces of any length, less than 1 1-16th inch diameter to be milled. The tongue under the base of the head is of steel, and can be removed to allow swiveling of head, so that work held in the chuck, such as hollow mills, etc., can be cut under or hooking. The tail stock has a milled-head adjusting screw, and screw to bind the spindle central in any position. These centers are designed to be used on the No. 2 Power Milling Machine, above described, and can be used on other milling, shaping, and planing machines.

This milling machine, with the dividing head, is made by E. E. Garvin & Co., machine tool manufacturers, 139, 141 & 143 Centre street, New York.

Universal Vise, and Tool Grinding Machine.

The Universal Vise, shown by a cut on this page, is intended for use on a die-sinking machine, milling machine or planer. It is very heavy in every part, especial care being taken to prevent springing. The chuck is like the ordinary form of planer chuck, with sliding bar provided with two holding-down bolts, and two steel-setting screws. This chuck, unlike the ordinary kind, is swung on centers between two upright lugs cast upon a bed-piece. It is tipped up and down by means of a steel screw working into a nut, which is held in place by two bearings, screwed fast to the chuck part, into which the trunnions on the sides of the nut are nicely fitted. A similar bearing is made fast to the bed-piece below, through which the end of the screw revolves. This arrangement enables the screw to assume any angle with the face of the chuck, without the least tendency to bind. The bed-piece is fitted with a pin in the center, projecting down so as to fill a hole made for it in the table of milling machine or planer, around which it revolves. It can be securely fastened in place by screws fitting into circular slots on each end, and provided with case-hardened steel nuts, planed to fit slots in a milling machine or other tool.

The centers are made of the best tool steel, and all other screws of best machinery steel. The vise will take in a piece 6″ × 12″, when the bar is in place.

The tool grinding machine, shown by another cut, was designed to meet the wants of the firm building them (Cox & Prentiss), and without any thought at that time of putting the machines upon the market. But they have been so much admired for compactness and general fitness for their work, that quite a number have been sold. The machine is cast in four pieces: The foot, the column (including arm for counter shaft), the table and the head. These are all fitted carefully together in the lathe, and firmly bolted. The shifting rod passes entirely through the column, and is fitted with pins to adjust the length of the throw.

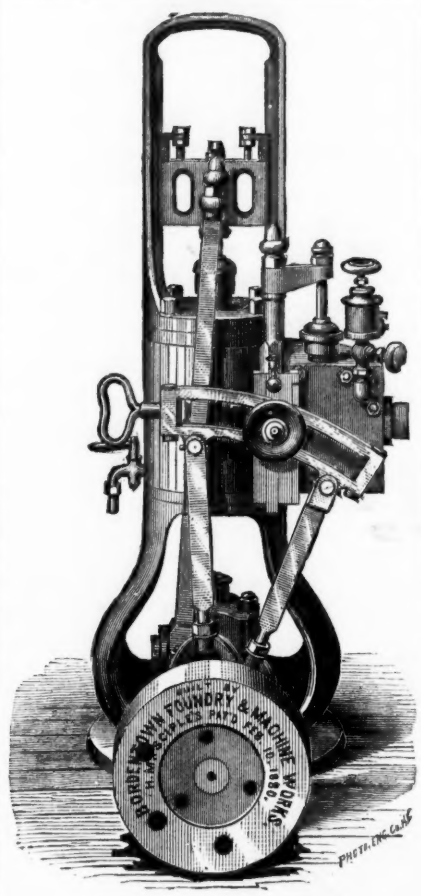
The peculiar features about the machine are in the head. The front and larger bearing is a cone, with the large end toward the back. The back end of the spindle is turned down to about ¾″ diameter, and lies in a box fitted with cap and end screw-bearing. As soon as the spindle gets the least bit of lost motion, it is easily taken up by loosening the check nut and pressing it forward into the cone-bearing, till it is as tight as required. The spindle is all in one piece, and is fitted with meshes, to hold one or more emery wheels. A rest is furnished, on which to place cutters, or anything else that must be held firmly. These machines, combining the counter shaft in themselves, can be set directly under the line shaft without loss of time, and may be driven off from the coupling, thus saving the labor and time required to put up an extra pulley.

These machines are made by Cox & Prentiss, Cleveland, O.

The Ohio Mechanics' Institute is about to establish a new department, to be called the department of science and arts, for the purpose of giving more attention to the application of correct scientific principles to industrial art. The plan will be to hold meetings for the discussion of new inventions and applications, and to procure the publication of such papers as may be deemed of value. A large number of new members have been obtained to join the department.

During the past year the out-put of the Leadville mines were 34,786 tons; bullion produced, $15,288,000. The product of mines, manufactories and other leading industries of Colorado were nearly forty-nine millions of dollars.

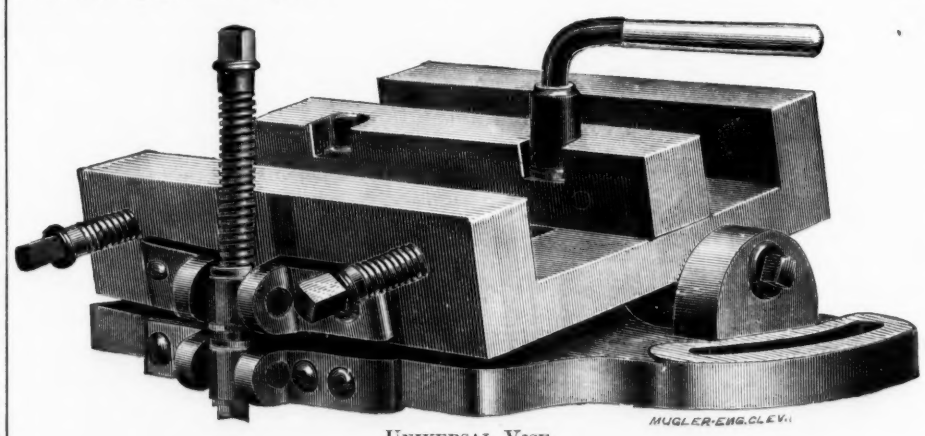
It is officially stated that 198,165,794 acres of land have been granted by the United States for rail and wagon roads. It would make 1,238,536 farms of 160 acres each, and its area is greater than that of the five States of Indiana, Illinois, Iowa, Kansas, and Minnesota. Its value at $2 per acre would be $306,331,588.



The Sciple Yacht Engine.

A general description of the Sciple engine and boiler appeared in our issue of January 22, 1881. The engraving shown above represents one of these engines, having a link motion and adapted for steam yachts, tug, or canal boats, or as a stationary engine, in which latter case the link motion can be dispensed with. The engraving represents the engine from which the data given in the latter part of our previous description was taken and requires no further explanation.

The Sciple engine is built by L. P. Thompson at the Bordentown Foundry and Machine Works, Bordentown, N. J.



UNIVERSAL VISE.

A lecture recently delivered by a Parsee, milling expert, Mr. M. F. Patell, B. A., gives a perfect insight into the condition of the spinning and weaving mills of Bombay Presidency, India. It may be interesting to know that Mr. Patell's views are considered sound. The first mill was started in 1854, and that since then, thirty-two in all have put in operation 10,000 looms, with 1,000,000 spindles, and given employment to 30,000 persons. The total capital invested is about £35,000,000.

Besides the Bombay mills there are in all India eighteen others, with some 340,000 spindles and 1,800 looms, involving a capital of say $6,000,000. The industry employs in all India an average of 1,000 hands to the mill. The highest number of spindles in one mill is 100,000, the lowest 4,800; average, 30,000. The average number of looms is 240.

Some ideas are harder to kill than a cayote. They cannot be run down, or starved, or frozen, The idea that a machine can be constructed which shall contain within itself a principle of perpetual motion, is one of these ghosts which "will not down," but rises continually to vex the thoughts of men. A Western man has recently patented a device which seems to show that he believes perpetual motion possible. It is a combination of a water wheel and pump, the wheel operating the pump to raise the water to run over the wheel again, and so on forever, we suppose. This is not a new idea, by any means, but if the patentee can serve any purpose by doing it, he is entitled to a patent for it.—*American Miller.*

New Bench and Hand Lathes.

One of the engravings shown on page 5, represents a convenient style of bench lathe and the other a hand lathe, both being built by George L. Fairbank, 89 Exchange street, Worcester, Mass. The bench lathe is suitable for attachment to either a wooden or an iron bench and is provided with counter shaft or foot power. These machines are built in sizes having from 7″ to 24″ swing.

The hand lathes are designed for amateurs or for localities where power cannot be readily obtained. They have all the modern appliances and are built with 3 feet, 4 feet, 5 feet and 6 feet beds, each having 11½″ swing. They have steel bearings, the boxes being scraped to a fit. They also have reversed cones, hollow spindles, and dead spindle lever for quick motion if desired. The workmanship is good and the lathes are well calculated to occupy the places where first-class tools are required.

TOOL GRINDING MACHINE.

The Chicago *Times* has ordered several type-setting machines from Belgium. The invention is said to work successfully, and a branch manufacturing establishment is to be founded in Chicago.

The annual report of Wells & Fargo show that the output of precious metals west of the Missouri river the past year, foots up nearly $70,000,000. Colorado leads the list of mining States in the amount of her production.

The prospects of the World's Fair for 1883 are becoming brighter, and we hope that all dissention will speedily be settled.

LETTERS FROM PRACTICAL MEN.

Moulders and Pattern Makers.

Editor American Machinist:

I had hoped the hints to foremen, machinists and pattern makers given by "A Foundryman," in your issue of the 25th of December, would bring out a few letters from practical men, giving some valuable information to the members of the branches of mechanics alluded to, particularly the latter, of which the writer is one. As to consulting a moulder about making a drawing or pattern, I agree with the "Pattern Maker" in your issue of the 15th of December. There are very few moulders, indeed, who can give an intelligent opinion as to how a thing ought to be done, *i. e.*, in its minor details, for the simple reason that they do not sufficiently understand draughting, and the nature of their trade does not require them to exercise their minds about things in the abstract.

If a moulder should offer a suggestion during the construction of a pattern, and the pattern maker happens to be "a regular graduate from the *best* school," he will not have his suggestion pass "unnoticed;" for a pattern maker of such acquirements will know there are different ways of doing things. Should the moulder happen to be "one of those chaps," experience and observation have taught the pattern maker, who strives to make his *own* way of more consequence than any other way, to reply that "the drawing calls for it," but "a regular graduate, etc.," needs but little information from the foundry, and, when it is needed, is not above asking for it. This voluntary information from the foundry is generally spontaneous. Evidently, "A Foundryman's" experience must be limited, for the faults of which he complains and desires to know why they are persisted in, are not practiced by *pattern makers*, hence need no explanation or apology from that source.

Bottom core prints, with taper enough to draw out of the sand without tearing it, are sufficient. Top prints are tapered more, so as to serve as a guide in centering the core, and admit its entering properly without crushing the mould. In many cases, where a moulder finds in taking a pattern out of the sand, that it has a "back draught," he has failed to comprehend how it should have been moulded, and has been too bigoted to seek the requisite information from the proper source. This want of harmony between the foundry and the pattern shop is no uncommon thing, particularly in shops under poor management and discipline. Under a mistaken idea in their management of men, the proprietors of these shops suffer yearly no small pecuniary loss, which accrues to the benefit of no one, but adds much to the annoyance and troubles of the shop life of many men, all of which, by properly directed effort, could be avoided, or at least, lessened, in a great degree.

A moulder's opinion of the pattern maker is like the latter's opinion of the draughtsman—unnecessary and premature, without being called upon for it.

R. D. KINNEY.

Macon, Ga.

Something About Couplings.

Editor American Machinist:

The remarks of your correspondents are far from exhausting the coupling topic. I feel as if I could write more (and perhaps say less) than about any other mechanical subject. Little unanimity of opinion is to be expected. You note the agreement of Chordal and Prof. Sweet; but they chiefly agree to differ with somebody else. It all depends on a man's early training and the route of experience by which he comes to the consideration of the thing. And then so many of us have had no early training up at all. I had a good start on the coupling question. "Oft in the stilly night" there haunts my dreams the rhythmical rig-a-jig-jig of the octagon cast-iron line-shaft, with unbolted clutch couplings which revolved in my

alma mater. Then we had a wooden shaft with winged gudgeons and a long line of rough iron screwed together. This combination, it must be allowed, was not a bad base line for a large experience.

There is the same difference in couplings that there is in clothing. A man who has always had his clothes made and fitted by a good tailor does not feel satisfied with a ready-made suit, and yet ready-made clothes are as good as many people deserve, and all they are willing to pay for.

Say that you want to couple two shafts so that they shall be as strong, as true and as lasting as a single shaft would be, were it possible to produce and transport it. This we could understand and very nearly attain. But you must have a cheap coupling, or one that you can pull down every week to change a pulley. This complicates the problem, and to suit all such demands we immediately acknowledge that there is no perfect coupling; there is none that is even absolutely best, and we might perhaps hold our sharpest debate over the most excellent.

I don't know every coupling that has been invented, but so far as I do know there is none better than the old flange coupling, and that I shall undoubtedly use when I put up my line shaft. I shall put up my shaft to stay. The coupling that is not just as good after repeated applications is so, because it was not very good in the first place. If I want to take power from the shaft at frequent intervals, the coupling shall be a pulley. Each of the shaft ends shall come through flush to the face, and the shafts shall be kept concentric by a male and female fit on the face. To have a long end on one shaft projecting into the other half coupling is mechanical injustice. I shall shrink the coupling on with a mild and gentle shrinkage, keeping the key ways together by a loose key until the job is cold. Iron keys are good enough for me, because I am by no means certain that steel ones are any better. Iron keys are less likely to work loose than steel ones if thoroughly fitted, and I do not think the trade so demoralized but that I could without difficulty find men capable of fitting them. The bolts ought to fill the holes. The coupling does not drive by mere friction, and if the bolts do not fill the holes one bolt may take more of the strain than another, and the coupling will be thrown somewhat out of truth. As to getting the bolts out to take a coupling apart it is an insignificant consideration. I would do nothing to facilitate the uncoupling of a shaft which is in good condition. The trouble about starting coupling bolts, as with many other things, is in the man rather than in the bolt. Bolts are battered up by using too light a hammer, and one important general rule for machinists is: *for driving anything in or out always use the heaviest hammer or sledge that can be practically employed.*

I would not have far to go to show you a long line of shafting coupled after my old fogy fashion, which has run for nearly thirty years (I dinna mind the biggin o't) without refitting a single coupling, and which is in better condition to-day than some other shafts I know of which, with *improved* couplings, have not run a year.

The most important thing to be said about couplings is not about couplings at all, but about belts. A coupling, like almost everything else in machinery, has its severest trial when first started. Probably the greatest strain which couplings have to stand is from the pull and leverage of heavy belting. A new line-shaft generally has to carry new belts. If these belts are put up dry, hard and stiff, as they come from the manufacturers—and they always are—they require an excruciating tension to enable them to drive anything, and of course the couplings have to stand the pull. It is generally only when they actually cannot be made to drive that we begin to think about greasing and softening and fitting them for their work.

I would like to compare notes with your correspondents as to the best treatment of belts. I think that the belts with which I have been familiar have not lasted as long as they should. Why is it that belts seldom wear out, but, apparently retaining most of their substance, lose their strength and begin to tear? What is the best grease, oil, or other stuff, to make them stick?

FRANK H. RICHARDS.

Troy, N. Y., Jan. 1, 1880.

Case Hardening.

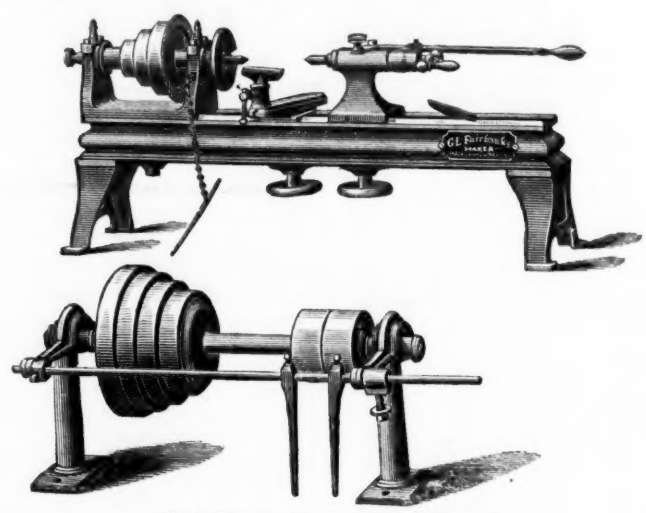
Editor American Machinist:

I noticed, in your issue of Jan. 22, that our friend "Pure Carbon," has taken it into his head to find considerable fault with my way of case hardening. I do not wish to start any argument about the matter, still, I think it my privilege to fully sustain what I have said. First, he says that it is not economical, as the bath is lost. I would say, in answer to this, that if the articles to be hardened are of so trifling a value as to consider the very small expense of materials used, it would be better not to harden them at all. Second, he condemns the manner of cooling, on the ground of its being dangerous to the eyes of the operator. If he says this from personal experience, all I have to say in answer is, he must be troubled with *myopia*, or he would not have had his eyes near enough to have been in any danger whatever, for I have used the same materials and in the same manner for ten years, and my eyes are right yet, and I have never apprehended any danger from it.

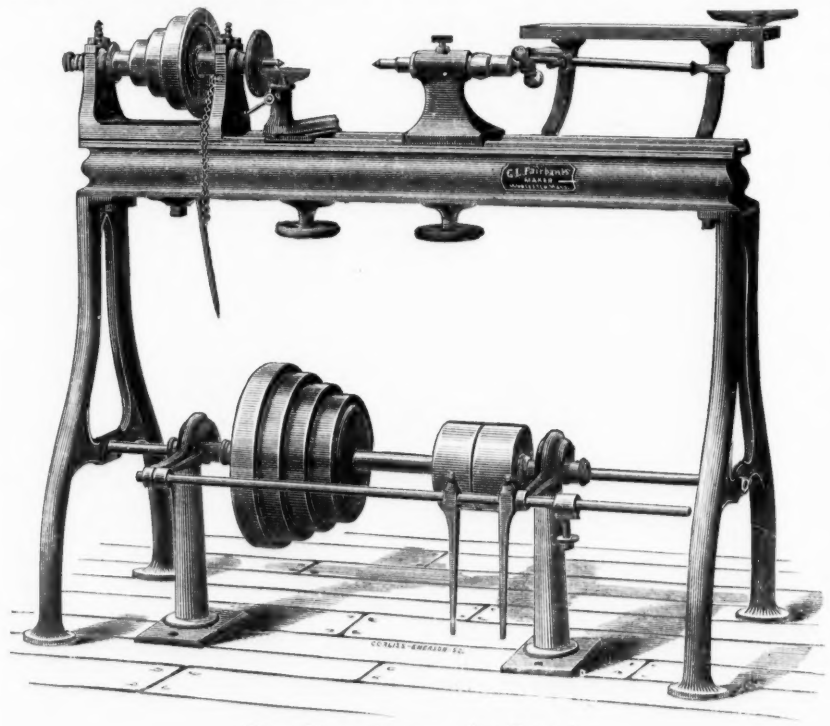
I empty the bath and its contents into the water together, in order to keep the pieces from coming in contact with the air, so they cannot oxidize. This accounts for their coming from the cooling bath so clean and of such a uniform gray color. The next reason why I don't save the salt and cyanide of potash is because it is *not good* to use twice. If it is left long enough in the fire to do the job well, too much of the cyanide will be burned away and absorbed to leave it good for anything to use again. I think if our brother "Carbon" had given the matter a little more thought, he could not have criticised my manner of cooling the work so strongly. Before closing these few remarks there are two things I would like to impress upon "Carbon's" mind. First: I always try to be sure of what I tell before telling it. Second: If I write it, I also sign my name at the bottom. Lastly, I have altogether too much respect for myself and for the AMERICAN MACHINIST to write an article on something I do not know anything about.

W. S. HARRIS.

Croton Falls, N. Y.



NEW BENCH LATHE.—See Page 4.



NEW HAND LATHE.—See Page 4.

real work must be done by the brain and hands; moreover, it is a very uncertain work, and in order to be successful, should not be intrusted to unpracticed hands. Perhaps, however, when the author of the article, to which I have called attention, starts the school he proposes, the element of uncertainty will be abolished, and all moulding thereafter placed upon a *sure* basis. When that is done, the second lot of castings can always be had, just like the first. But before this greatly-desired result shall have been reached, certain little details must be perfected. All the sand used must be analyzed, so as not to get varieties improperly mixed. A machine must be devised to ram every piece, so as to have each just so—hard or soft. The right temperature needed for the sand must be determined. Some pieces require heavier sand than others, and after the casting is taken from the sand, the moisture is more or less evaporated. Certainty of results makes it necessary to determine exactly the moisture lost, and to replace exactly that amount, at the same time getting it evenly distributed. In order to do this perfectly, an individual must have a deeper knowledge of science than any one has ever yet possessed.

Our critic declares that he has never seen a machinist who had any respect for a moulder. He must have been in contact with a very jealous lot of machinists, who, for some mysterious reason, were hostile to moulders. He furthermore says that, if he complains to a moulder of any defect in a casting, he cannot depend upon anything the moulder may assign as the cause of the failure. The fact is a moulder might tell him all about it, but the critic, who knows little or nothing about moulding, would probably not understand the explanation; nor would he, if habitually distrustful of what his fellow artisans tell him, believe anything the moulder might advance as the cause of the disappointment.

It is somewhat amusing to read his exclamation—"Who supposes that a moulder ever saw the inside of a mechanical journal!" I, for one, know that they read the AMERICAN MACHINIST more than he has any idea of, and doubtless not a few of them have enjoyed the fun of perusing his somewhat crude vituperations. A good moulder is governed by sound judgment and practical experience, and I should be sorry to hear of one so far forgetting himself as to blindly assail his brother craftsmen with charges of general incompetency. He cannot sit beside a machine and watch it do its work. Our critic does not believe that the conditions of production in the foundry are necessarily uncertain and uncontrollable. It was the opinion of no less a philosopher than Benjamin Franklin that nothing is certain in this world except death and taxation. But, seriously, this expression reveals our critic's lack of knowledge upon the process and results of iron moulding. Ask any of the best moulders, when they have an unusually particular piece of work to perform, if they are sure of a good casting and see what they will reply. Let our critic read the account of making a monster casting in the AMERICAN MACHINIST of October 30th, 1880, and he will get an idea of some of the uncertainties of moulding. It is hardly to be supposed that the moulder who cast that piece could be more interested in his work; yet he exhibited great anxiety as to the result.

I saw a short time since a pulley 12 feet diameter by 33 inches face, double arm, weighing 8,500 pounds, moulded by one of our best foundrymen, whose reputation extends throughout the country. Through some unknown cause the casting was spoiled—not by reason of lack of interest in the work. In conclusion I will say that our critic need not exercise his benignant powers of forgiveness upon moulders, for they will never beseech him to do so.

A MOULDER.

North Andover, Mass.

A Moulder Answers a Complaint.

Editor American Machinist:

As a common moulder I wish to defend my fellow craftsmen from the insinuations in "Notes of a Foreman," which appeared in the AMERICAN MACHINIST some weeks ago. He first finds fault because he cannot tell whether his castings will come out good or bad, and never knows when he can get them. This, I admit, is a fact, and if he were a moulder, he would know the reason why. Moulding is an art which cannot be carried on by automatic machinery. The

Hints to Pattern Makers and Moulders.

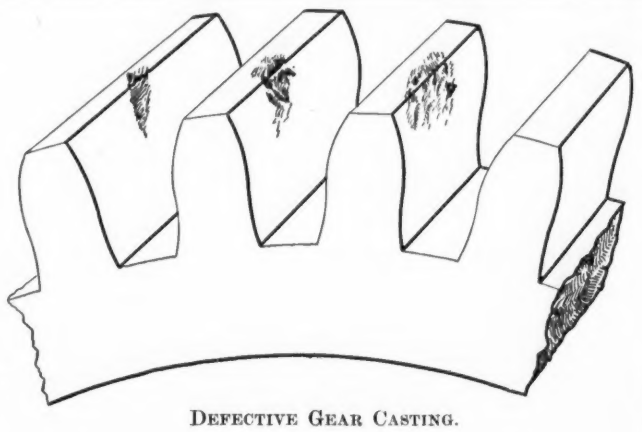
Editor American Machinist:

My friend, the pattern maker from Yonkers, did not make it clear to my mind about those core prints.

In my first I asked the pattern-making fraternity why they persisted in making the bottom print on a hub straight. I have been making a few inquiries of professional pattern makers, and they one and all, so far, have admitted that there is no reason but habit and custom. There are many reasons (at least two) why they should be tapered; 1. To have the sand undisturbed; 2. A core print, 2 inches or more in diameter, and ½ inch or 1 inch thick, made with grain of wood transverse, allows the dampness to enter the wood, causing the lower surface to expand, so that the print becomes dovetailed into the sand, if originally straight. A good, generous taper will avoid all the

trouble, and a file will easily trim the core to match the taper of the print.

Our friend from Yonkers claims, with some degree of respect, that "a real competent pattern maker" has no need for the opinion of the foundryman, as he knows as much about moulding as draughting, etc. I must say that this is just the rock on which many a good pattern maker and good foundryman have split, when by being a little more considerate in regard to the opinions of each other, the harmony and success of many a manufacturing establishment would be enhanced. By admitting that some one else knew, or could give an idea of how best to do it, a cloudy day might appear brighter. A great many patterns are made that *can be moulded*, but the important question in these days of active competition is: Which is the shortest road? The expenditure of a few hours time on a pattern oftentimes saves hundreds in the life of that pattern in the foundry. So I say to all persons who have dealings with foundrymen, let us reason together, and give credit to those who are daily and hourly engaged in their business, discovering little kinks that are entitled to respectful consideration.



DEFECTIVE GEAR CASTING.

Now I wish to offer a few hints to foundrymen. Some castings have imperfections very puzzling to the foundrymen to ascertain the cause. Perhaps there are those who can point out the cause, but I am certain there are many more who cannot. In the casting of spur gear wheels of small or high teeth and wide-webbed arms, it often happens that the teeth or cogs are "cold shot" or wrinkled. The appearance of the tooth is as if a quantity of dry sand had been sifted upon it. I have known moulders, in such instances, to be accused of having sand in their moulds. The cause of this difficulty lies in the web on the arm. As the metal is poured in it begins to rise in the teeth. When the web on the arm is reached by the rising metal it flows over the banks, so to speak, and during that interval of time the upward movement of the metal is arrested. The liquid metal in the spaces of the teeth "freezes over," a thin film is formed, and when the metal has again filled the banks and again begins to ascend, this film does not melt nor break, but literally bends and forms a cavity in the tooth (see engraving). The remedy is to fill the mould as quickly as possible with sharp iron, and put a weak facing, or no facing at all, on the part of the tooth opposite to the web on the arm. This same defect occurs on many milling machine beds or stands, where the flange is wide and thin and the body broad.

A great deal of valuable time is wasted in foundries by venting plain copes. A mould that is perfectly plain or but slightly irregular—1″ or less projection—never needs a vent wire on the cope. Such work wastes time and defaces the pattern, because, if the plate is thin, the metal has to be poured so quickly that the gates are full, and a pressure is exerted upon the cope before steam is made to any extent. If the plate be 2″ or more in thickness, the cope will be baked hard as a brick by the intense heat before the iron reaches it.

A FOUNDRYMAN.

Toledo, Ohio.

Laying out Cone Pulleys.

Editor American Machinist:

In a former number of your paper I find a question by one "T. A. R.," of Newburgh, N.Y., relating to cone pulleys. This is a subject I feel interested in, and tried to work out the problem by the rule you gave. I regret to say, however, that I do not fully understand the formula, and will ask you if you will have the kindness to illustrate the rule by an example.

I take pleasure in transmitting herewith a diagram showing a method of construction, which is as follows: Taking your figures for an example, the speed of driving shaft at 100 revolutions, carrying a 20″ pulley, the driven shaft also running 100 revolutions and the belt on a 20″ pulley, then the speeds required for the driven shaft

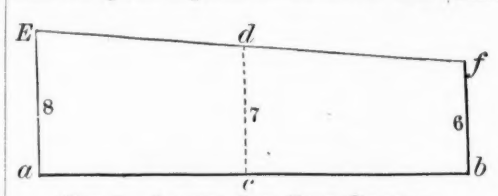


FIG. 1.—LAYING OUT CONE PULLEYS.

will be 75—100—150 and 225. I will add to this the distance between centers of shafts 8 feet. Draw the line *a b* (see diagram Fig. 1), 8 feet long; bisect this, and at *c* erect a perpendicular. From *a* and *b* draw the given circles 20″ diameter, and the tangent *g h*, intersecting the perpendicular at *d*; *c d* in this case being also 20″. Now find the proportions between the speed of the driving shaft (100), and the required speeds of the driven, which are 100:75=1:¾, and 100:100=1:1, and 100:150=1:1½, and 100:225=1:2¼. Making *c d* the mean proportional of each of the above, we have, in the first, a ratio of 1 to ¾, *c d* divided into seven equal parts, making one extreme eight and the other six, the latter being ¾ of the former, and *c d* the mean. Having set off 8 spaces on perpendicular *a* and *b*, on perpendicular *b*, draw the line *e f*, to which draw tangential circles 1 and 1′ (as in Fig. 2), which are the two pulleys required for the first step.

The second being a ratio of 100 to 100, both pulleys are of equal diameters (20″ in this case), *g h*, the tangent, also passing through *d*.

The third—100:150=1:1½—makes *c d* the mean. Again, by dividing *c d* into five equal parts, making *a*=4 and *b*=6, set off these spaces as before and draw *i k*, to which draw tangential circles 3 and 3′.

The fourth being a ratio of 1 to 2¼, divide *c d*, into thirteen equal parts. Make *a*=8, and *b*=18. Draw line *l m*, and tangential circles 4 and 4′, which will complete the two cones.

By this rule a driving cone may be easily constructed to run with a cone already made. For example, with a lathe having a cone of 4, 6, 8 and 10 inches diameter, let it be required to construct a cone on the driving shaft, the latter making 100 revolutions; greatest speed of lathe to be 300; distance between centers of shafts, 8 feet.

Reference is here made to Fig. 2 for illustration only, as the diameters of the steps are as follows: *l*=4″, *i*=6″, *g*=8″, and *e*=10″. Draw line *a b*, 8 feet long; erect perpendiculars at *a* and *b*; draw the given cone at *a*; then bisect *a b*, at *c*, erect perpendicular, *c d*, then from *b*, draw a circle 12″ in diameter. This will be the largest pulley on the driving cone, giving the required 300 revolutions to the lathe and determining the length of the belt.

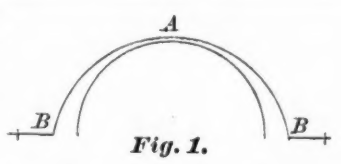


Fig. 1.

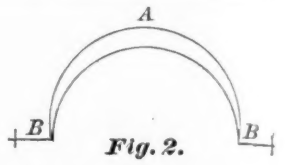


Fig. 2.

Now draw tangent *l m*, intersecting *e* at *d*; then draw tangents *i*, *g*, and *e*, all passing through *d*, and at the driving shaft end the tangential circles *k*, *h*, and *f*, from the center *b*. This will be the cone required.

This rule may be used in all cases, except where the two shafts are very close together, when there would be a slight discrepancy, which can, however, be very easily corrected on the diagram. If the shafts were an infinite distance apart, it would be mathematically correct.

OTTO FUCHS,
Principal Boston City Evening Drawing School.

Finishing a Steel Journal.

Editor American Machinist:

Fitting up journals is something that I am somewhat interested in, and as my ideas do not agree exactly with those that have been written on this subject, I will give you some of my views, and the way I have obtained a very good journal.

In the first place a good center must be obtained, that fits the center in lathe. It must be made round by a counter-sink reamer, instead of making it with a center punch, as some do; for if the countersink in the shaft is not round, the journal will not be round. After the journal is nearly to the required size, take a square nose tool, drawn out so as to give a thin cutting edge; set as high on shaft as possible, without riding the shaft, and have the tool cut on the shaft as little more than the feed, as possible. In this way there is as little cutting surface as can be obtained, and by taking a light cut while running slow (no tool will turn a shaft round and run fast), you will obtain a good journal nearly round. I do not believe any mode of polishing will make it more perfect Lead clamps may show the imperfect spots, but will not lessen them. I use pine clamps, emery and oil, with an iron clamp dog, to give even pressure and keep the clamp on the move. As soon as the tool marks are out, I lay the clamps one side and use a piece of fine emery cloth to put on a finishing touch by hand. This is my mode of finishing a steel journal.

A. D.

Grand Rapids, Mich.

Fitting Split Pulleys, Couplings, &c.

Editor American Machinist:

Fig. 1 shows the true way to fit a split pulley, coupling, etc. That is, bore the hole the least trifle larger than the shaft. (The figure shows the difference in excess for the purpose of making the idea plain.) Then the bolts at *BB*, will bring the hole to a perfect bearing upon the shaft all around. The hole, if bored too small, (as in Fig. 2) will only fit the shaft in two places, as at *BB*. A slight grip all around the shaft will hold better than a hard grip at two points only. Bore the pulley, so it will slide on the shaft comfortably. A pulley thus fitted will "stay," and run right, not having keys or set screws to throw it out of true. Set screws, in many places, are unmechanical, and oftentimes dangerous. Avoid revolving set-screw heads as you would avoid the plague.

Bernardstown, Mass. H. NORTON.

Hardening Cast Steel.

Editor American Machinist:

I would like to offer some suggestions to steel workers on the subject of hardening.

First, I would suggest that the expression, so common, "too hard," be dropped, and, as a substitute, *too hot*, be adopted. Can a cutting tool, for wood or metal, be too hard, if it has, at the same time, sufficient tenacity? Why is a diamond superior to hardened steel for cutting glass? Why is not the hardest tool which can be used without breaking, the most desirable for cutting metals and wood? Why should a tool be hardened to be as brittle as glass, and the temper drawn to prevent its breaking in use, when it can be made, by hardening at a lower heat, hard as glass, and so tough as to be next to impossible to break it? *How hot* may steel be heated? is the all important question; not *how* shall it be done?

Among the numberless *sure* methods, the advocates of which respectively advise or condemn the use of hard and soft coals or coke, gas jets and gas furnaces, packing in animal carbon, heating in liquid baths of lead, or prussiate or cyanide of potash, with the variety of accompanying ingredients, powders, washes, and dips, to be used before heating, and after heating, and while heating. With the great variety of quenching compounds, from oils to quicksilver, not

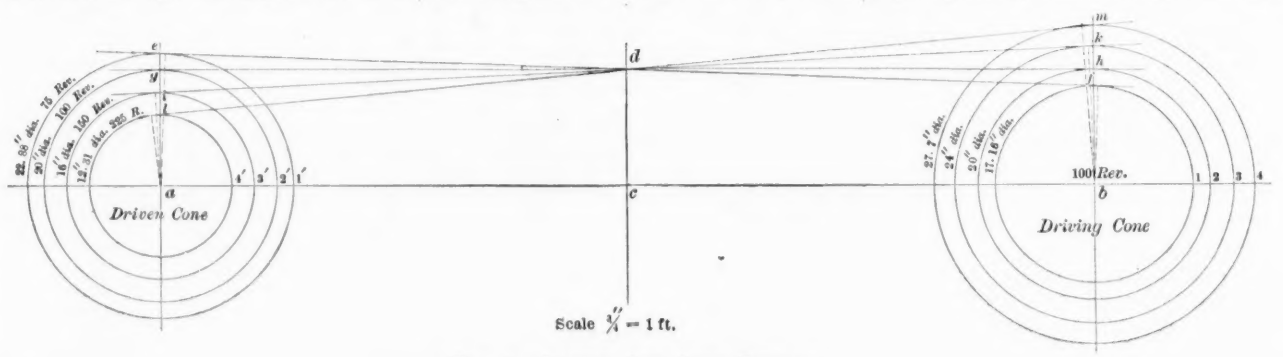


FIG. 2.—LAYING OUT CONE PULLEYS.

one is so good but the tool hardened by it will be virtually ruined if heated too hot. Not one is so bad that good results may not be obtained if the heat is right.

Steel, hardened at too great a heat, becomes coarse in grain and brittle, just in proportion as the heat is too great, while if hardened at the right heat, the grain will be finer and the steel stronger than before hardening. Keeping this fact in view, the steel worker, with a few experiments, should be able to so harden tools that many operations of cutting hard metals, (which were not simply difficult, but impossible, with tools hardened to snap like glass and temper drawn to toughen them), will become certain and easy. In no other condition is steel as valuable for both hardness and tenacity, and, consequently, for efficiency and durability, as that called "refined by hardening."

If any particular grade of steel will not become sufficiently hard at the refining heat, instead of striving to reach the desired end by hardening at a higher heat, throw aside the steel and get a higher grade.

Under no circumstances overheat or burn steel with the expectation that it can be restored to be either better or as good as before, for it *can not*. If by accident steel is overheated, it can be restored by subjecting it to a low heat and allowing it to cool off gradually as for annealing, after

which it may be hardened at a low heat in the usual way. If there is a chance to forge, or in any other way work the burnt steel at a low heat, so much the better. As there are different degrees and conditions of overheating, so will the restoration process show different results, depending upon the care exercised; as well as upon the amount of injury sustained by the steel previous to restoring. But in no case will it be as good as that which has not been overheated. Restoring, in this case, is simply "refining by hardening." Surely, the piece of steel, which has been so overheated as to become coarse in grain as pig iron and more brittle than chalk, cannot be as good as that which, having the grain properly closed up by working, is properly heated for annealing and hardening. Whenever asked to try any particular restoring compound, and then harden at a *low heat;* first, try the *low heat* without the compound. Respectfully,

S. W. GOODYEAR.

Pittsburgh, Pa.

Work of a Small Cupola.

Editor American Machinist:

I send you the following record of the working of a small cupola in our foundry, which possibly may be of interest to your readers. It may not be anything remarkable, or more than is usually performed, but, as it seems to us to be a fair day's work, we would be pleased to hear of a better one under similar circumstances.

This work was done Dec. 23, 1880. The weather was clear and pleasant, with a very light northwest wind, and the thermometer indicating an average temperature of about 40° F.

Our cupola measures 26 inches inside diameter at the melting point, and the blast is given by a No. 4 fan-blower through two 5-inch tuyeres.

The fire was lighted at 10.30 A. M., and at 10.45 we commenced charging with coal, putting up 550 lbs. This occupied thirty minutes. At 11.32 we commenced charging with iron, using the Glendon Iron Co.'s No. 1 South Easton pig iron, and No, 1 scrap.

At 11.50, or in one hour and twenty minutes from the time of starting the fire, the blast was put on, the blower making 2,590 revolutions per minute, which speed was increased to 2,960 revolutions at 12 o'clock. At 12.07 P. M., or in sixteen minutes after the blast was put on, the iron was running out of the temp, and the temp was then stopped. At 12.15 we put up 168 lbs. of coal. The first tapping was made at 12.25, or in eighteen minutes from the time of stopping up. The blower was then making 3,145 revolutions.

At 12.35 the second tapping was made; at 12.48 168 lbs. of coal were put up. The third tapping was made at 12.47; the fourth at 1.02 P. M., and the fifth at 1.15, with the blower making 3,320 revolutions. At 1.25 the right-hand tuyere showed itself a little dark, but it was clear again at 1.35, at which time the sixth tapping was made. The seventh tapping was made at 1.45, and, as slag had shown itself quite freely, we allowed the furnace to "blow" for five minutes. At 1.47 we put up 112 lbs. of coal. The eighth tapping was made at 2 o'clock, and 112 lbs. more of coal put up. The furnace showed less slag, and the iron came "sharper" at this tapping. The ninth tapping was made at 2.10, and the tenth (a small one) at 2.17. This small tapping was made to complete the quantity of iron required for the shape, which was a bevel gear ring. At 2.20 the ladle was swung off, with 5,384 lbs. of iron. We commenced pouring at 2.24, and completed it at 2.26. In addition to this casting, we poured several flasks of small work, which was all completed at 2.43 and the blast taken off, and the bottom dropped at 2.49. The whole time consumed was four hours and nineteen minutes.

The time of melting was two hours and fifty-three minutes.

Amount of pig iron melted	3,550 lbs.
Amount of scrap iron melted	3,593 lbs.
Total amount of iron melted	7,143 lbs.
Amount of castings	5,045 lbs.
Amount gates, sprues, trench, etc.	1,565 lbs.
Total amount of melted iron	6,610 lbs.
Amount of waste (7143″—6610″=)	533 lbs.
Percentage of waste, $7\frac{46}{100}$.	
Amount of coal used	1,108 lbs.
Amount of coal left	40 lbs.
Net amount of coal used	1,068 lbs.

Amount of iron melted with one pound of coal was $6\frac{69}{100}$ pounds.

Average time of first nine (which were full) tappings was 15 minutes and 34 seconds.

Average weight of the same, 598 pounds.

The rate of melting was $38\frac{56}{100}$ pounds per minute for the first nine tappings, and $38\frac{9}{16}$ pounds per minute for the entire melt, and at the time we stopped we were maintaning this rate. The iron was coming sharp and in good order, and, judging from the appearance of the cupola, after the bottom was dropped, we could have continued at the same rate and conditions for an hour, or an hour and a half, longer.

Gardiner, Me. GEO. M. HOLMES.

Names and Definitions of Files.

We have received from Kearney & Foot, 78 Chambers street, New York, an illustrated descriptive catalogue of files, with considerable information for users of files prepared by James D. Foot, of that firm. We copy the following definitions of the different grades and shapes of files:

In describing the various grades of cuts, we take as a standard our 12-inch file, using an inch section from the center of the file.

The grades are divided as follows: Rough, Bastard, Second Cut, Smooth and Dead Smooth.

These five grades are those most in use, and are made from or by two separate cuts on the file, which forms a diamond-shaped tooth. The first cut which is put on the file is known as the "over cut," and the second as the "up cut." For "mill saw" and "taper saw" files only, the "over cut" is used to form the tooth, the tooth being a sharp ridge of metal extending at a sharp angle across the face of the file, and not intersected by any other stroke of the cutting chisel. This last tooth, as applied to mills and tapers, goes under the two grades of bastard and second cut. The only other tooth which is in use is that applied to horse rasps, wood rasps, cabinet rasps and shoe rasps. This tooth is raised to a conical form by the use of a punch. On horse rasps it is too large to designate by any grade of cut. On wood and cabinet rasps it is graded under the head of bastard, smooth, and sometimes second cut. As a matter of convenience, the grade of the tooth is given by counting only one of the cuts of the file, and we take for this the "over cut" or first cut.

The wood rasps and cabinet rasps having a punched or raised tooth (each tooth being separate from the other), we give the exact number to the square inch.

Rough is formed of twenty-two teeth to the running inch.

Bastard is formed of thirty-two teeth to the running inch.

Second cut is formed of forty-four teeth to the running inch.

Smooth cut is formed of sixty-eight teeth to the running inch.

Dead smooth is formed of 120 teeth to the running inch.

Mill bastard is formed of a series of diagonal teeth thirty-six to the inch.

Mill second cut is formed of a series of diagonal teeth forty-four to the inch.

Taper saw single cut, second cut, is formed of a series of diagonal teeth fifty to the inch.

Wood rasps have a punched tooth known as bastard grade, 105 teeth to the inch.

Cabinet rasps have a punched tooth known as smooth, 300 teeth to the inch.

Cabinet rasps have a punched tooth known as second cut, 186 teeth to the inch.

FLAT.—A double-cut file, made up of the five grades of cut, previously mentioned, namely, rough, bastard, second cut, smooth and dead smooth. The double cut applies to the sides of the file, the edges being single cut; on special orders the file is made with single-cut sides and of the five above-mentioned grades.

In shape, this file is as a rule of parallel sides and thickness for two-thirds its length, and from that distance to the end is drawn to a blunt point, in a gradual decreasing width and thickness.

HALF ROUND.—A file in grade of cut the same as "flat." It is cut on the flat side the same as a "flat" file, or double cut. On the half-round side in a series of rows of single cuts from shank to point, completely covering it. Some of the rows intersect at different angles; where this occurs it gives the file the appearance of being double cut. In shape, of the same width as the various sizes of "flat" files; and drawn to a point in the same way as a "flat" file, only differing from a "flat" in being between a half round and half oval.

HAND.—A file in cut and grade of cut the same as "flat." It is of the same width at the point or end as at the shank or tang end. It is gradually drawn down in thickness from about two-thirds its length to the end, leaving it at the end about one-half its original thickness. Sometimes it is drawn very slightly from the center to the tang as regards its thickness. One edge of the file is left uncut and given the name of "safe edge." These files are sometimes made with two safe edges.

PILLAR.—A file in cut and grade of cut the same as "flat." In other respects the same as a hand, with two exceptions. It is only from $\frac{1}{3}$ to $\frac{2}{3}$ the width, and in proportion to its width is of greater diameter than a hand.

EQUALING.—A file in cut and grade of cut the same as "flat." In every other respect, with one exception the same as "hand." It is not only of parallel width, but of parallel thickness.

COTTER OR PIVOT.—A file in cut and grade of cut the same as a "flat." In shape a very narrow "pillar."

SQUARE.—A file in cut and grade of cut the same as "flat." It is of equal width and thickness for about two-thirds its length; from there to the end it is gradually drawn to a point, its square shape being retained. Frequently the point or end is left of the same thickness as the tang end. It is then called "Parallel Square."

ROUND.—A file in grade of cut the same as "flat," the cut being made up or comprising a number of rows of single cuts extending from shank to point, the rows slightly intersecting. It is gradually drawn to a point, from about two-thirds its length to the end. Sometimes the file is left the same thickness at the point or end as at the tang end; it is then called "parallel round."

THREE SQUARE.—A file in cut and grade of cut the same as "flat." It is in dimensions of triangular shape, giving the file three sharp corners, which vary in sharpness according to grade of cut. It is of uniform dimensions for about two-thirds its length, and is drawn gradually to a point from that distance to the end. There are also "parallel three square" files, these files being the same thickness at the point as at the tang end.

MILLSAW.—A file of single cut, generally of two grades of cut; bastard and second cut, and sometimes a smooth cut. It is flat in shape, slightly drawn at the point, both in thickness and in width, and though of about the same width as a flat file, is not so thick. It is generally cut with one round and one square edge, very often with both edges square, and sometimes with both round edges and with one safe edge. By machinists it is often called a "float file."

TAPER SAW.—A file sold largely under the following heads:—Taper saw, single cut, slim taper saw single cut, band taper saw single cut, and taper saw double cut. As a rule a file of single cut graded as second cut. It is often cut in all its shapes with a double cut graded as second cut. It is triangular in shape, being forged to a point the same as a "three square."

TAPER SAW, SINGLE CUT.—A file graded as "second-cut, triangular in shape, being cut on the three sides, also cut on three edges. As a rule cut within a short distance of the end.

SLIM TAPER SAW, SINGLE CUT.—The same in every particular as the "taper saw," only made from stock two thirds as heavy.

BAND TAPER SAW, SINGLE CUT.—Is the same as "taper saw" in shape; the sides are cut the same as "taper saw." Its edges are ground, rounding, and cut with two rows of teeth to each edge.

DOUBLE CUT TAPER SAW.—A file in shape the same as "taper saw," the edges being cut, and the sides receiving a double cut "second cut" instead of single cut.

CROSSING.—A file graded the same as flat. Oval in shape, with two sharp edges, being forged and drawn gradually, from about two-thirds its length to the point. It is cut the same as the back or half round side of the "half round" file.

CABINET RASPS.—In every respect but two the same as a "wood rasp." Instead of being "half round," it is scant "half oval," and in grade of tooth it is a "smooth," sometimes a "second cut."

CABINET FILE.—In shape like a cabinet rasp. On flat side it is double cut, and grade of "bastard." On the oval side it is the same grade of cut or bastard half round.

WOOD RASPS.—In shape, both flat, round, and half round, and corresponding in this particular to the "flat," "round" and "half round" files. The tooth is conical, being raised from the surface of the rasp with a punch, raising a tooth about equal to the space it removes from the surface. As regards grade of cut, is generally known as "Bastard."

WARDING FILE.—A file in cut and grade of cut the same as "flat." It is seldom made over eight inches in length. In appearance very much like a flat file—differing in three ways. It is forged more to a point than a "flat," and compared with the same length of "flat" file, is not so thick but has more width.

JOINT FILE.—In shape a thin equaling. It is cut on the edges only, and is sometimes made with round and sometimes with square edges, according to the wishes of the buyer. It is known also as a "drill" file. As regards thickness it can be ordered by numbers, according to Stubs' metal gauge.

Newly-Incorporated Companies.

NEW YORK.

Brooklyn, Rockaway and Coney Island Railway Company. Martin B. Brown, Thomas Keech and others, incorporators. Capital, $250,000, in shares of $100 each. To construct, maintain and operate a railroad company in the town of Flatbush, Kings County, and running through the town of Flatbush along and across Jamaica Bay to Rockaway Beach. Length about ten miles; also to have a branch about three miles in length to a point on Coney Island on or near Sheepshead Bay and Ocean avenue, in the town of Gravesend. Jan. 13.

Rand Directory Company of New York City. James Helion, James O'Kane and others, incorporators. Capital $100,000, in shares of $25 each. To print, publish and manufacture books, newspapers, periodicals and pictures. Jan. 13.

American Electric Gas Machine Company, New York. Henry N. Hooper, Wallace M. Pope and others, incorporators. Capital $6,000,000, in shares of $100 each. For the manufacture and sale of machines and appliances for the generation of electricity, steam or gas by electricity, or by chemical means or processes. Jan. 14.

Hudson River Cement Company of Ulster and Rosendale, New York. E. M. Bringham, Samuel D. Coykendall, and others, incorporators. Capital 100,000, in shares of $100 each. For the manufacture and sale of all kinds of cement, and all other articles used in connection therewith. Jan. 14.

The Richmond Manufacturing Company, Lockport. Wm. Richmond, Wm. McLean, Jr., and others, incorporators. Capital, $20,000, in shares of $100 each. For the manufacture and sale of mill and grain-cleaning machinery and machinery for transmitting motive power, etc. Jan. 15.

Morrell Sugar Evaporator Company, New York. James A. Morrell, Francis H. Holton, and others, incorporators. Capital, $5,000,000, in shares of $100 each. For the manufacture and sale of evaporators and appurtenances thereto, under invention and process of James A. Morrell, and to sell territorial rights and licences to others to use the same. Jan. 15.

Alleghany Iron and Coke Company, New York. Charles S. Hurd, Wm. H. Garner, and others, incorporators. Capital, $250,000, in shares of $25 each. For the mining of coal and the manufacture and sale of pig iron and coke. Jan. 15.

The Lesher Petroleum Novelty Company, New York. Henry S. Lesher, George S. Abrahams, and others, incorporators. Capital, $50,000, in shares of $25 each. For the manufacture of petroleum and cotton seed oil, and other ingredients, all kinds of toilet articles, soaps, candles, hair restoratives, camphor ices, etc. Jan. 17.

Binghamton Hoe and Tool Company, Binghamton. Jno. Jay Warden, Charles McKinney and others, incorporators. Capital, $25,000, with privilege of increasing to $100,000, in shares of $100 each. For the manufacture and sale of hoes, tools and agricultural implements. Jan. 17.

MASSACHUSETTS.

Renfrew Mills, Adams. Levi L. Brown, president; James C. Chalmers, treasurer. Capital, $200,000, in shares of $100 each. For the manufacture of cotton, wool and worsted fabrics. Jan. 13.

The Rogers & Bacon Piano Company, Boston. Edwin A. Eaton, president; Henry G. Horton, treasurer. Capital, $225,000, in shares of $100 each. For the manufacture and sale of pianos, and all business incidental therto. Jan. 15.

The Inter-State Improvement and Construction Company, Stamford, Conn. J. R. Maxwell, Alfred Rully and others, incorporators. Capital, $300,000; shares $100 each. For the construction of railroads by contract, and to deal in all manner of railroad supplies and equipments. Jan. 12.

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery; nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers inventors, draughtsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

NEW YORK, FEBRUARY 5, 1881.

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The printed date on each wrapper shows the time to which the subscription is paid. We discontinue the paper in all cases when the time paid for has expired, unless renewed.

Permanency in Industrial Exhibitions.

The Philadelphia Permanent Exhibition has been heard from again, in a little news item, which finds its way into the press. The directors have recommended the shareholders that the show be closed, the exhibits removed, the building sold, and the affairs of the concern wound up. Perhaps it would be proper for us to say that we regret the failure of the enterprise, but we refrain. It is really surprising to note that it has lasted four years. Since the fair got into settled operation a few weeks after starting, and the reports of daily admissions could no longer be considered interesting news for the daily papers, the show has been heard from by the public only when somebody got a leg or arm chewed up by the machinery, something got broken to pieces by the running off of a belt, a fire licked up a few cases of hair oil, boot blacking, or haberdashery; or the directors fell to quarreling among themselves about opening the show on Sunday, or upon some other matter of public importance. For some months, however, none of these items have appeared, which, of course, would lead newspaper readers to suppose that all lively interest had departed from the concern.

The fact is, permanent exhibitions don't pay—except upon paper. A year or two before the Centennial, a huge permanent industrial exhibition was instituted (by circulars and advertisements) in New York City. Large amounts of stock were sold by the Industrial Exhibition Company, and drawings for prizes were to take place. When the time for drawing arrived, the managers drew themselves away, thus insuring the financial success of the undertaking.

The managers of the Philadelphia enterprise surprised a great many shrewd financiers by organizing a literal and veritable show of the products of art and industry. This example indicates what a surprising difference there is in methods of carrying out similar projects.

The success of annual industrial exhibitions must have misled the public-spirited projectors of the Quaker City permanent institution. The success of any public affair depends largely upon the support of the press. The permanent exhhibition can not secure this assistance for any considerable time, and we will give some of the reasons why. After it has opened with *eclat* and got right down to the steady unchangeable work of "astonishing and delighting visitors" throughout the four seasons of the year, it don't furnish the pressmuch entertaining material for publication. When the hot sultry dog days arrive it gives the wide awake journalist no opportunity to bring out, afresh, the periodical stock item of news that "The fair of the Great Columbian Institute this fall will be unusually interesting and attractive. The managers have spared no pains or expense, etc." Then the directors of the great permanent aggregation are not favored with regularly recurring opportunities to send (supposed) impecunious editors and reporters free passes, or bunches of tickets, with the polite request that they would be pleased to exchange courtesies during the continuance of the fair. Then there are no annual opening pageants through the streets of the city to rouse popular enthusiasm, by long processions of gayly decorated lager beer trucks, soap wagons, patent medicine chariots and gingerbread bakeries on wheels. Besides this unavoidable lack of resources the permanent show cannot furnish the press every fall with the regular opening address of some celebrated Colonel, General or Honorable, reciting, in magniloquent phrases, the former glories of the institution, throwing in a few references to the gorgeousness of the present display and winding up by predicting what the population of the United States would be in 1900, and what rapid advances we may expect in the price of up-town lots. Again, the permanent exhibition gives the enterprising technical journals no regular annual apportunity to "write up" the fair, fourteen years in succession, each time bringing out, as entirely new, the usual complimentary notices—

The Squirt Pump Works make a very interesting and attractive display of their patent improved double back acting lightning steam pumps in actual operation. These pumps are very extensively used by breweries, distilleries, tanneries, hog-killing establishments, etc., throughout the country. They are very popular on account of their simplicity, effectiveness, durability and excellent workmanship, One feature of these pumps deserves more than a mere passing notice. They work equally well with either hard or soft water.

Then, when the ides of November are reached in the calendar, there is no regular and positive dependence upon the permanent show to furnish material for the seasonable item of news, that "the Squirt Pump Works were awarded a bronze medal and diploma at the fair of the Great Columbian Institute, which closed last week. This is a well-merited compliment, etc."

The fact is, and might as well be acknowledged, that the permanent exhibition is a stumbling block to so much bright newspaper enterprise, that it cannot permanently succeed, for nothing that is antagonistic to the spirit of the press can hope to flourish in this progressive land of ours. The managers of the Philadelphia show may, therefore, wisely determine to take down their sign, close up the business, and divide the profits—if there are any.

Millwright or Mechanical Engineer?

One of our correspondents, who writes that he has had more than twenty-five years' experience in the erection of mills, writes us suggesting the idea of devoting some portion of our columns to the interests of "another class of mechanics who are closely allied to the machinist." He presents the claims of this class as follows:

I belong to a fraternity large in numbers, who have long been recognized as important members of the mechanical community, a class whose names are seldom seen in business directories, or in your advertising columns, in connection with their special business; a class of men who are seldom educated in our colleges or scientific schools, and who can acquire proficiency in their business only by the long-continued application of sound mechanical common sense to the solution of the original mechanical problems which they are constantly called upon to solve; a class of men who must give a large part of the best of their lives to serve an apprenticeship in some branch of their business, before they are recognized as masters of the trade—whose business is of an intermittent character; who are frequently required to operate in unknown or unexplored fields, to produce certain results for which there are no precedents, and for which no instructions or information can be obtained: who are required to plan and construct a large majority of the industrial establishments in the land; who, in a large measure, direct the expenditure of many millions of money in enterprises, the financial success or failure of which may depend upon their ability to expend the money judiciously; who are supposed to know all about all kinds of buildings for manufacturing purposes—all about all kinds of steam engines and boilers and the relative merits of the various methods of setting and operating them ; who are supposed to be capable of giving a reliable opinion as to the merits of every system of heating, lighting and ventilating and fire protection; who are required to furnish estimates of the power to be obtained from streams in which flow an unknown quantity of water, varying from nothing to a flood, and with an unknown fall, and to state positively whether such water privileges can drive the machinery in mills requiring an unknown amount of power; who are supposed to know all about all kinds of turbines and other water wheels, to give opinions as to their relative merits, and be capable of designing and constructing a turbine which shall embody some crotchet of the customer and excel every other wheel on the market; who are expected to make drawings for everything, also make patterns for the foundryman (involving a knowledge of foundry work), direct the machinist how to fit his part of the work (involving a knowledge of the machinist's trade); who are required to make computations of the strength and speed of engines and water wheels, gears, shafting, pulleys and belts, with all the necessary foundations, connections and fixtures, and put the same in position for successful operation, and who are cursed and subjected to damages if they fail.

The above schedule of requirements is certainly ample enough to require about a quarter of a century's experience to attain. But what is the reward? We will let our correspondent tell it in his own words:

I become indignant when I remember what we usually worry through in a lifetime, only to die in poverty. Although in one way or another we do accomplish the greater part of what is required of us, and much of it for the magnificent remuneration of three dollars per day, or less, for the time we are able to work, getting nothing for traveling time and expenses, nor for the thousand and one explorations, examinations and surveys of mills and mill sites, nor for the weeks spent in making sketches on floors, doors, benches, boards, old envelopes and on the sidewalk; nor for making endless arithmetical computations, to show the patronizing customer what he can or cannot do (usually the latter); nor for the lost time occasioned by sickness, caused by exposure in wheel pits and engine rooms in the night, and frequently in the winter, in water without fins, when we get a day's pay and lose two weeks in recovering.

In fact, Mr. Editor, I don't think we have had a fair chance, and think if you call the attention of our patrons to the fact, they will be willing to expect less, and pay more; for I can assure you, as you may infer from what I have written, that if all the knowledge and information our patrons require of us were published in one book, it would be an immense volume, which could be equaled in size only by the publication of another one, containing what we don't know about it.

The letter of our correspondent concludes with the request that we devote "a little corner" in the AMERICAN MACHINIST to that ill-appreciated, painstaking servant of the manufacturing public, who is known as the "Millwright." In considering this subject we naturally make inquiry at the outset as to the meaning of the designation, "Millwright." By Webster we find the word defined as "a mechanic whose occupation is to build mills," and by Worcester, "a person who constructs mills." These definitions are certainly not comprehensive enough to define the status of the individual whose qualifications are outlined above by our correspondent. Turning to a former issue of the AMERICAN MACHINIST we find another correspondent expressing himself in this way :

"A millwright is one who constructs mills, and mills now-a-days are unquestionably constructed by engineers, machinists, blacksmiths, pattern makers and founders. In fact, the word millwright is nearly, and should be quite, obsolete, and properly belongs to the days when a man who had a superficial knowledge of and a certain small amount of dexterity in each of the above branches, was privileged to waste his employer's time, and very often his material also, under this synonym for a Jack-of-all-trades."

This represents rather an extreme view, and one we should not wholly commend. Fortunately our correspondent, who so earnestly advocates the claims of millwrights, encloses his business card, and turning to that slip of pasteboard, as a last resort, we find MECHANICAL ENGINEER standing there in the boldest type. The answer to the inquiry is now very easy. A millwright is a mechanical engineer who makes a specialty of mill work, and the word might as well be dropped from the language. We have had the pleasure of publishing quite a number of practical communications from that class of mechanics, and hope to hear from many more in the same way.

Literary Notes.

A PRACTICAL TREATISE ON THE STEAM ENGINE.—Containing plans, arrangements and details of fixed steam engines, with essays on the principles involved in their design and construction, by Arthur Rigg, engineer, Member of the Society of Engineers and of the Royal Institute of Great Britain. New edition, demy 4to; in twelve parts, or bound in cloth, illustrated by wood cuts and 96 plates. $10. Published by E. & F. N. Spon, 446 Broome street, New York.

This work is not in any sense an elementary treatise, or history of the steam engine. But without entering into a general treatise on marine and locomotive engines, treats of fixed or stationary steam engines as they are found to-day. This book gives examples of the leading engines in use throughout the European countries. Plans and details are given in abundance, together

with formulas relating to proportioning the different parts. The velocity of reciprocating parts is well treated, and will interest engineers generally. The data given are only those which have been found in practice to be correct. Besides being a complete treatise on the steam engine, we may say that the plates form a series of excellent copies for the young draughtsman and the engineer, as they are of a style in actual use, and the proportions may be used in making models. The price of the former edition was $17, and we are glad to see a reduction in the price, as it places the book better within the reach of ordinary mechanics and apprentices, whose means will not allow them to purchase the more expensive books.

New York's prosperity is indicated by the fact that the real estate valuation this year is fixed at $980,789,999; increase over last year, $38,000,000. The elevated railroads account for much of the improvement.

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) C. H. H., Toronto, Ont., asks: (1) Would you please give me a rule for determining the velocity and actual discharge of water from circular orifices, per second, under different pressures—say nozzles as used by fire brigades? Also a rule to determine height to which water can be thrown from same with different pressures? *A.*—To answer your question would involve the writing of a short treatise on the subject, and involves all the conditions that affect each particular case. There are many engineering text books which give formulas for computing the flow of water from orifices, but most of them are right only in theory. The particles of water are supposed to move among themselves with such a degree of freedom, that they would escape from an opening or orifice with the same velocity as a stone would be moving, which had fallen through a distance equal to the head in feet above the orifice. The formula for obtaining the velocity in feet per second is "$v = \sqrt{2gH}$," or the velocity in feet per second = 8.025 $\sqrt{}$ height of fall in feet. From the above we obtain the volume per minute of any jet of known diameter by multiplying the velocity per second by 60 to find the length of the jet per minute; multiplying this by the cross section of the opening, expressed in feet, we have the contents of the jet in cubic feet, which, multiplied by 7.48, the number of United States gallons of 231 cubic inches in one cubic foot, gives us in gallons the contents of the jet during one minute. Example—What will be the discharge through an inch orifice under 67 pounds pressure? Stating this by the latter method we should have—gallons per minute = 99.85 × 0.00546 × 448.8 (a constant used in the place of 60x7.48) = 244.67+. (2) What is the maximum and average duty in foot pounds per 100 pounds coal consumed, of high pressure non-expansive Worthington pump? *A.*—The actual duty of the Worthington pumping engines in foot pounds is given as follows in Mr. Worthington's book on his pumping system, viz: High pressure form 20,000,000, Compound, 35,000,000, and the Compound Condensing, 80,000,000.

(2) S. T., St. Louis, Mo, writes: We have in our building 46 steam coils, aggregating in all 13,490 lineal feet of one-inch pipe. We have also three Otis elevator engines to furnish steam for. I find it very difficult to make steam this cold weather. We burned 75 bushels of coal in heating the store and running one day. It was with the greatest effort the fireman could maintain 45 pounds of steam. My boiler is 60 inches in diameter, 18 feet long, with 20 tubes 6 inches in diameter. Bridge wall is 6 in. from boiler. Space under boiler, commencing at rear of bridge wall to end of boiler, is 12 inches. Space on sides, between boiler and side walls, 6 in. Space between end of boiler and rear wall, 14 inches. Area of chimney, 750 square inches—30 inches in diameter. Furnace is 4 feet long, 6 feet wide, grate bars are 30 inches from boiler. I think I ought to do the work easily with half the coal. I have a fine draught. *A.*—Steam pipes, where not used for heating purposes by radiation, as for instance between the boiler and radiators, should be well protected by jacketing. Your boiler ought to develop about 70 H.P. under favorable circumstances. You do not state the kind of coal used; but taking it for granted that you burn soft coal, we would suggest the following changes, viz: The space over bridge wall had better be 7 inches. Space under the boiler, back of bridge wall, should be 18 in. at least, in order to allow the gases to remain ignited and ensure perfect combustion. The space between end of boiler and rear wall ought to be 20 inches. The grate bars should be at least 28 inches from the boiler to get the full benefit of the combustion of soft coal.

(3) C. C. O., Philadelphia, Penn., asks: Please give me a formula for calculating the pressure to allow a boiler, the diameter and thickness of boiler plate being given. *A.*—Formula: $P = T \times C \div D$ in which P = Bursting pressure, D = Diameter of shell, C = Constant, being 1097 for single riveted iron, and 1372 for double riveted; 1723 for single riveted steel, and 2156 for double riveted. The stays upon the heads should be 5½" from center to center. If these directions are followed, the boiler will be likely to give satisfaction.

(4) A. R. S., Trenton, N. J., writes: In your paper of January 8, 1881, you stated that you could not give a definite answer to my question, as I did not state the name of the cup, or the kind of oil we used. The cup is one of N. Seibert's Eureka Lubricators, with a drop feed. The oil used is the Binghampton cylinder oil, and costs 65 cents per gallon, having a thick, black body. My employer thinks that I use too much oil, and I wish to convince myself if he is right. Size of engine is 12" x 24", running 75 revolutions per minute, developing about 25 H. P. *A.*—If your engine is in good condition and the cylinder smooth, a pint of the oil referred to ought to last a day, (10 hours) but we have known cases where a quart of oil was used every day, in consequence of the wearing surfaces of the engine being in bad condition.

(5) G. W. J., Cleveland, O., writes: I had an argument with a friend about the running of the trucks of railroad cars on curves. He maintains that the draft, or taper on the tread of the wheels, make up for the longer distance the wheel running upon the outside rail has to travel by running up close to the rail; the rim of the other wheel running on its smallest part. He also claims that one wheel cannot slip without causing the other to do the same, if both are tight on the same axle. I claim that coning the wheels helps to a certain degree, but not to such an extent as to accommodate itself to all curves, therefore one or the other must slip. Which is correct? *A.*—If a pair of conical-shaped car wheels be placed upon a curved track of a proper radius to suit the conical shape of the wheels, they might possibly follow the curve, but the direction of a wheel is governed by the position of the axle. To illustrate: Suppose we have a small car, having two axles parallel to each other, and four wheels of equal diameters: If the car be set in motion upon a plane surface it will move in a straight line. Again, if two of the wheels on the same side of the car be reduced an inch or so in diameter, the car will still move in a straight line. A car upon a railroad track in striking a curve is inclined to move on in a straight line, but is prevented by the flanges upon the wheels. The outer flange upon the leading wheel of the truck wears the most and receives the shock, being pressed with great force against the outer rail, causing the inside wheel upon the same axle to slip backward in order to pass around the curve, while the flange upon the outer wheel of the trailing axle does not touch the rail at all. The flange of the inner wheel does touch the rail slightly. These wheels slip about equally, the one forward and the other backward, in passing around a curve, as they are free from the excessive flange friction to which the outer leading wheel is subjected. The following from the proceedings of a late meeting of the Lime Kiln Club, of Detroit, as related by the Detroit *Free Press*, may throw further light upon the subject: "The Secretary of the 'African Order of Modern Philosophy,' which holds forth at Kent, O., forwarded an official communication asking Brother Gardiner's assistance. The order believed that when a train of cars rounded a curve the outer wheels either slid ahead to keep up with the inner ones, or else the latter slid back to prevent going ahead of the outer ones. Some held to one theory and some to the other, but all agreed to leave it to the decision of the President of the Lime Kiln Club. For half a minute it seemed as if the old man was stuck. He scratched his head, looked up and down the hall and hitched about in his seat. Then he got his cue, and rose up and said: 'Dey haven't sent 'long 'nuff perticklers about dat case. Dey doan' give de name of de railroad. Dey doan' say which way de train am gwine. Dey doan, say how many passengers am aboard, nor give de name of de conductor. When dey have furnished dis information I shall be werry glad to furnish my opinyun on de queshun at issue.'"

(6) J. H., Newark, N. J., asks: Please inform me of some simple rule to find the number of teeth for small mills, and also to get the right spiral, or pitch for cutting the same in the Brown and Sharpe machine. I am rather dull at figures. *A.*—There is no fixed rule for the number or the spiral of teeth in milling cutters. But for mills, from 2" to 3" in diameter, the teeth should be made about 3/16 inch apart. Larger than three inches from 7-16 to 1-2 inch, will be about right for the generality of work. This is easily obtained by dividing the circumference obtained in eighths, by 3. in the first instance, and so on. Brown & Sharpe usually make the angle of spiral about 10° or 12° which makes the pitch of spiral about 16 times the diameter of mill, or for a mill 3" in diameter make the spiral 1 turn in 48". The angle will then be 11° 7', if figured accurately from the formula as given in the table accompanying the B. & S. machine. In multiplying the diameter by 16 you will not always produce a number for the pitch which can be cut with the change gears; but taking the nearest number in the table, and if it be less than the number desired, make the angle a little more than 11°. If more make the angle a little less than 11° and you will be near enough right for all practical purposes.

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See Christiana Machine Co.'s adver., on page 14.

James W. See, Designing and Consulting Engineer, Hamilton, Ohio.

Engines Indicated—Power Measured. W. H. Odell, Box 274, Yonkers, N. Y.

"Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. $1.50 by mail, postpaid. American Machinist Publishing Co., 96 Fulton Street, New York.

J. C. Hoadley, Engineer and Expert, formerly of Lawrence, Mass., has opened an office at 29 High St., cor. Federal, Boston, Mass., where he will be pleased to receive old and new friends.

MANUFACTURES.

The Porter-Allen High-Speed Engine Works (Southwark Foundry and Machine Co.), of Philadelphia, are putting in new tools, and fitting up as fast as possible, for supplying their numerous orders for engines. They are now setting up a 600 horse power (22 inches by 36 inches) engine for the Globe Nail Co., Boston, which will make 200 revolutions a minute. Last week they were offered orders for 7,000 horse power, most of which they had to refuse.

E. E. Garvin & Co. have been engaged in the manufacture of machine tools at 139, 141 and 143 Centre Street, New York, for about two years. They began in a small way, but now have sixty men constantly employed, and find it difficult to keep up with their orders, which come from all parts of the country. They have recently made some important improvements in milling machines and other tools, which are set forth in a new illustrated catalogue just issued.

The Crane Brothers' Manufacturing Co., Chicago, report an increase in the demand for elevator and other work, being several months behind their orders. In some of the departments the works are run day and night.

The George F. Blake Manufacturing Co., Boston, have just completed a large addition to their factory. They have just shipped one of their improved duplex high-pressure pumping engines, of two and a half million gallons daily capacity, to furnish water for the city of La Crosse, Wis., and are now erecting at Maysville, Ky., two vertical pumping engines of three and a half million gallons combined capacity. This company have a large number of orders, and are running full on extra time.—*Boston Bulletin.*

The Link Belt Machinery Co. of Chicago, manufacturers of machinery, are placing in their establishment about ten thousand dollars worth of improved machinery for their business, and will soon be in active operation. One hundred men will find employment in these works at once.

The South Boston Iron Works finished a large casting weighing 72 tons several days ago for a mining concern in Pennsylvania.

Rohan Brothers, boiler makers, of St. Louis, having secured the now vacant lot on Collins Street, immediately north of their shops, have begun the erection of an additional shop 100x55 feet, which is to be used for the purposes of their business,—*Age of Steel.*

Ninety-two vessels, with an aggregate tonnage of only 35,847, were built in Maine during the year just closed. This was less than half the tonnage of 1877, since which year there has been annually a decrease. The prospect for the present year is believed to be a little better.

Ware & Weld, Worcester, Mass., have a very practical and safe method of mounting emery wheels, which not only prevents their bursting, but precludes their flying to pieces with much force. They are introducing their "gem" emery wheels with good success, also some special emery-grinding machinery.

Jones & Laughlins, Pittsburgh, Pa., are adding a chain factory to their establishment.

The Lewis Foundry and machine Company, Limited, a new corporation in Pittsburgh, Pa., are erecting a new iron foundry.

C. Hennsler, Thrift File Works, Philadelphia, is extending his premises and putting in more machinery.

The Philadelphia, Wilmington and Baltimore Railroad Company are erecting a new boiler and blacksmith shop at Wilmington, Del.

The proprietors of the Lake Shore Foundry, Chicago, have recently purchased two blocks, Nos. 73 and 100, in the town of Cornell or Grand Crossing, on South Chicago avenue, near Stony Island boulevard, for $5,000 and will immediately commence to erect a foundry for casting, which will give employment to 350 men.

A. Aller, 109 Liberty street, New York, writes us:

We are placing a great many of the Korting universal injectors, steam blowers, steam-blast nozzles and machines in our line. The prospects for the coming year are very bright, and we expect to do a larger business than ever before. Have just received medals for our different machines recently exhibited at American Institute Fair.

The large stone and frame pipe foundry, at Conshohocken, Pa., together with machine shop, carpenter shop, blacksmith shop, etc., has been sold to C. W. Lowrie for $25,000, subject to a debt of $87,000.

The Western Wheel Scraper Co., of Mt. Pleasant, Ia., has built an addition to its works 30x88 feet, making the total dimensions 270x40 feet, about one-half of which is two stories high. Their sales of wheel scrapers last year were five times as large as in 1879, orders being received from nearly every State and Territory in this country, and from Canada. As soon as the weather will permit, the company will break ground for new buildings, and will double the capacity of their works. They are now adding to the machinery in the present works.—*Railway Review.*

The Union Brass Manufacturing Co., Chicago, one week lately, contracted for the trimmings on 205 cars, and are several months behind in their orders. On the 1st of March this company will erect a substantial addition to their works.

The Hendey Machine Company, Wolcottville, Conn., write us;

We doubled our facilities for building our planers and shapers for metal-working, early in 1880, thinking we should then be able to meet all demands, but trade in the new and popular tool comes faster than we could expect, and we are again about doubling our facilities. Yet we are told that then we shall feel the need of further means to turn them off, and certain it will be so, if the demand continues as it has set in since the first of the year. We need a number of good machinists. Our hands have done well the past year. Most of them working twelve and thirteen hours as long as they could stand it, then working ten hours per day until they became rested.

H. L. Shepard & Co., 331, 333, 335 and 337 W. Front St., Cincinnati, O., write us:

Business in our line is flourishing, and we are receiving all the orders we can possibly attend to. The outlook for the present year is for a largely increased business over any past year, and the great number of inquiries we are daily receiving convinces us that better times have reached others as well as ourselves.

The Pennsylvania Steel Works at Harrisburg have just been started up, after an idleness of eighteen months.

The new buildings of the Brush Electric Light Co. in Cleveland, which cover more than a square, are rapidly approaching completion, and the tools and machinery are being put in as rapidly as possible. Several hundred men will be employed.

The Edgemoor Iron Co., near Wilmington, Del., have lately closed contracts with railroad companies for 3,000,000 pounds of iron, and are now working on it.

The F. C. Wells Steam Pump Works, of Chicago, have recently added several new machines to their establishment. which they run day and night.

Richardson Bros., saw manufacturers, of Newark, are about to occupy their new buildings, rebuilt since the fire on December 11. They will employ 175 hands in the new shop.

The Brush Electric Light Co., of New York, are to enlarge their present station on Twenty-fifth street, and erect seven more stations.

Machinists' and Engineers' Supplies.

NEW YORK, Jan. 20, 1881.

The transactions in supplies during the week have been large considering the means of transportation. All the dealers appear to be pleased with the outlook and are exerting themselves to stock their stores. We hear of no changes in prices worthy of notice.

Kearney & Foote, 78 Chambers St., New York, have just issued a new catalogue, describing the different grades of files made by them. The book is illustrated with very fine engravings of files, shapes and sections, which renders it very desirable for reference, both to dealers and consumers.

The Baldwin Locomotive Works, of Philadelphia, Penn., have issued a second edition of their catalogue, which is gotten up in a very attractive style, for distribution among the patrons and friends of this large establishment. A birds-eye view of the works forms the frontispiece of the book and is followed by a well-written sketch of the life and works of Matthias W. Baldwin, the founder of the establishment. This sketch contains some very interesting accounts of the early experiments made during the period when the success of the locomotive was a matter of doubt. The work contains detailed descriptio s, together with valuable data relating to the successful performance of the Baldwin locomotive. Each class of locomotive is illustrated by photographs with tables of dimensions and weights annexed. The binding is cloth, neatly trimmed in gilt.

Iron and Metal Review.

NEW YORK, January 20, 1881.

The iron market is firm in tone, prices are steady and considerable business has been transacted during the week. Prices are as follows: Foundry, No. 1, $25. Foundry, No. 2, $22. Gray Forge, $20, $21. The sales of Scotch Pig have been large and on account of an advance in ocean freights, an advance of 50 cents to $1.00 a ton on last week's quotations is asked by holders. Prices are quoted as follows: Eglinton, $22@$22.50. Combroc, $22.50. Coltness, $24.50@$25. Glengarnock and Gartsherrie $23.50@$24. The inquiry for steel rails is very active and a heavy business has been done in old rails; an advance of $1 to $2 per ton being asked above prices which would have been accepted a short time ago. We hear of no changes in manufactured iron.

LUCIUS HART & CO., 8 & 10 Burling Slip, New York, furnish us the following to-day:

The metal market has been without material change during the past week. Fair jobbing demand continues. Pig Tin, in London, £89 for Straits; Singapore, $27¾.

Would quote Spot market nominally. Banca Tin, 25c.; Malacca and Straits 20¼c. and up; Australian and Billiton 20c. to 20¼c.; "Lamb & Flag," 20¼c.; Bar Tin, 22c.; Pig Lead steady at 5¼c. to 5¼c.; Antimony, 15c. for ordinary brands 15½c. to 16c. for Cookson; Spelter strong and steady at 5¼c. for Domestic; "Bertha," pure, 8c. and upwards; Solder No. 1, 11½c.; "Half and Half," 13½c.; Bismuth, $2.50 per lb.

WANTED

A Draughtsman of 10 years practical experience wants a position—address A. C., MACHINIST OFFICE.

Wanted.—An experienced Machine Tool Draughtsman with prospect of permanent situation at good wages. Address, stating experience, salary desired, &c., "Tool Shop" care AMERICAN MACHINIST.

Manufacturers desiring the services of an advanced mechanic, competent to organize and construct special tools and machinery for, and manage the systematic manufacture of sewing or other light machines, will find such by addressing Box 5, office AMERICAN MACHINIST, 96 Fulton St., N. Y.

Situation wanted by a practical machinist, draughtsman and designer. Have had long experience as manager and foreman in machine shop. Address, F. F., care AMERICAN MACHINIST.

Wanted.—By an experienced man, a situation as manager or foreman in an engine or general machine shop. Highest testimonials. Address, J. H. L., 5 Ann St., Allegheny City, Pa.

Wanted.—A position as foreman of a Boiler shop; am well acquainted with all kinds of boiler work and have had the management of men for 20 years. The best of reference given. Address, E. S. M., care AMERICAN MACHINIST, 96 Fulton Street, N. Y.

Wanted, about February 1st., a situation by a good smart Mechanic of 25 years experience, has at present charge of 25 Steam Engines, condensing and non-condensing, including Buckeye, Corliss and others. References from past and present employers as to sobriety and ability. Address, Go Ahead, office AMERICAN MACHINIST, 96 Fulton Street, N. Y.

Wanted.—Eight or ten sober and capable machinists to whom good wages and steady work will be given. The Hendey Machine Co., Wolcottville, Conn.

Situation wanted as engineer by a young man experienced in the management of high and low pressure engines. Can do pipe fitting, shaft hanging and general repairs. Understands Corliss engines. Address, J. M., care AMERICAN MACHINIST.

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Manufacturers of Wilson's Patent Free Open Double Disk
LEVER VALVE,
for Steam or Water, from 1¼" to 6". This valve has peculiar merits as a throttle valve for steam engines, and is well adapted to the use of a Sawyer's Valve, in place of the butterfly. Send for our catalogue and price list.

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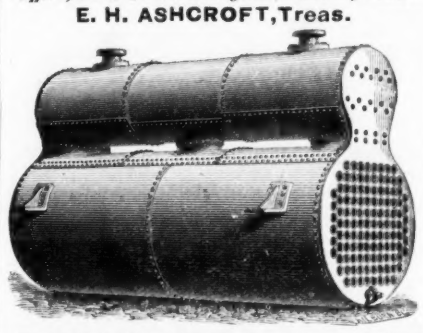
Office, 51 & 53 Sudbury St., Boston, Mass.
E. H. ASHCROFT, Treas.

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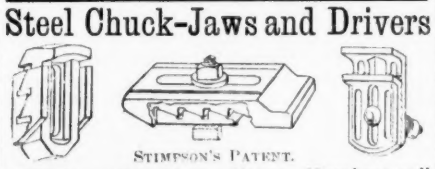
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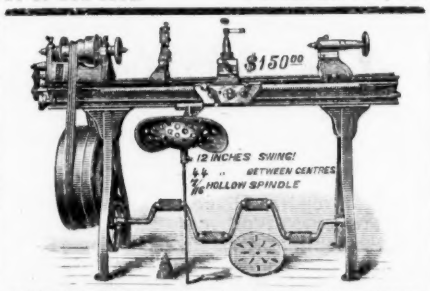

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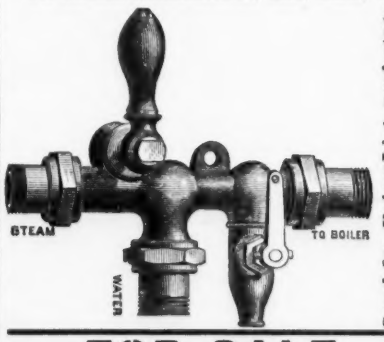

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The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.
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JAS. D. FOOT, Esq., Waterbury, Conn., Nov. 8th, 1878.
Dear Sir:—Please forward the order for Files given you a few days since. Your Files have been uniformly satisfactory to us. Yours respectfully,
FARREL FOUNDRY & MACHINE CO., E. C. LEWIS, Ag't.
We print instructions on the use of Files, and also give the diameters of round and square Files from 3 to 16 inches. They are on card board, 10x12 in., and are intended to be put up in the shop for the men to read. We are pleased to mail them to any manufacturer on receipt of the necessary 6 cents postage.
Respectfully, KEARNEY & FOOT.

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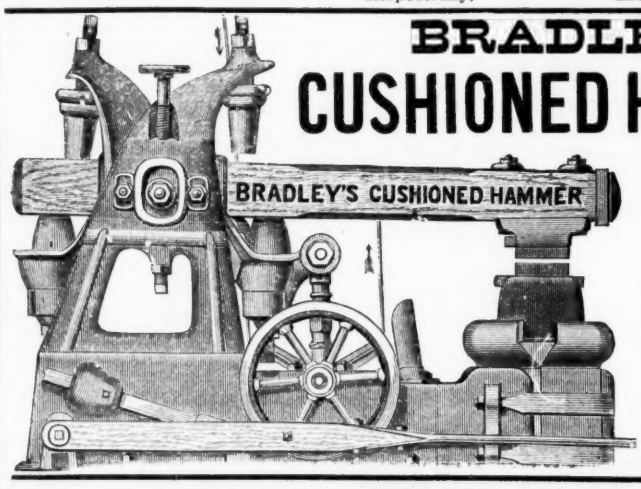

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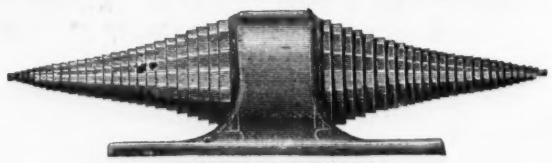
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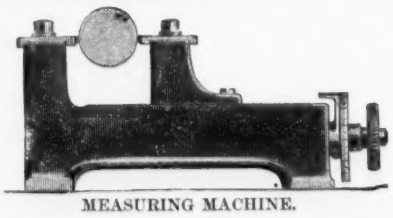
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